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A Monthly Journal of Engineering Progress

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IN many cases RIC-WIL Conduit for underground steam and hot water pipes costs no more than an ordinary makeshift of channel pipe and farm drain. But RIC-WIL gives your client a highly efficient compact interlocking system that will serve him without trouble indefinitely.

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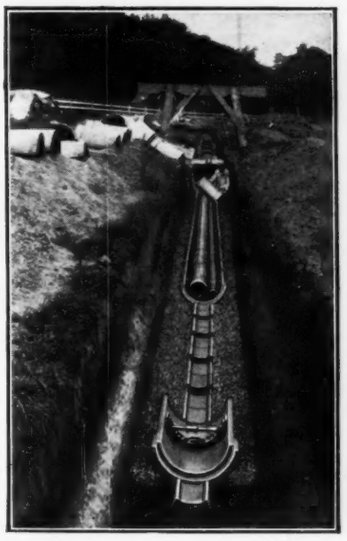
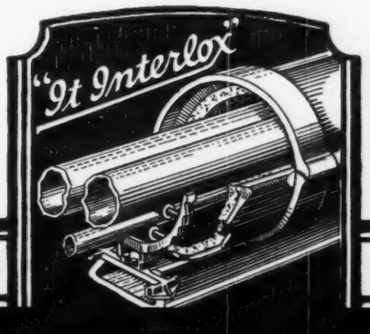


Clear evidence of the sensible construction and easy installation of RIC-WIL.

RIC 

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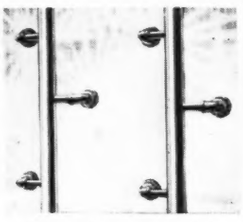
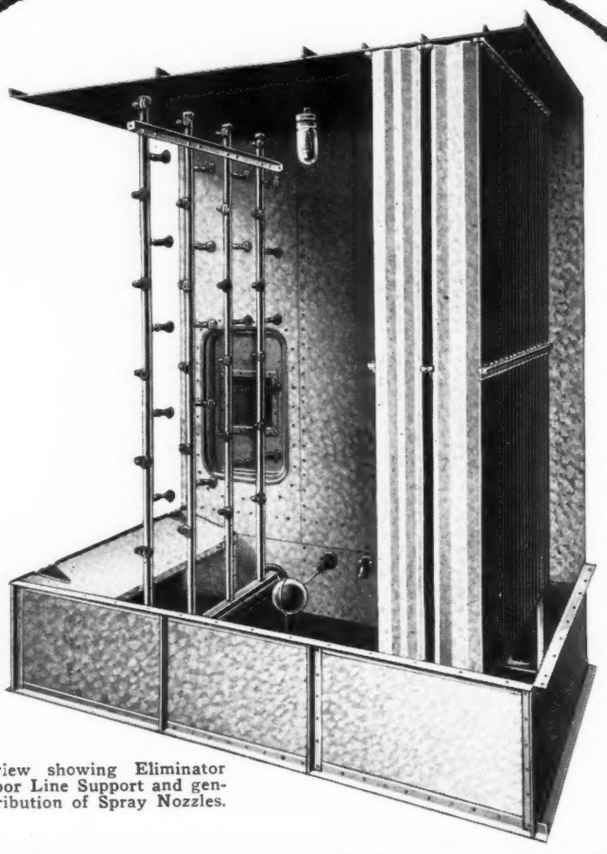
UNDERGROUND CONDUIT~~



Spray Nozzles which create an unbroken mist screen



Interior view showing Eliminator Plates, Floor Line Support and generous distribution of Spray Nozzles.

Assembled view of Type "V" Washer

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CLARAGE
AIR WASHERS

The Heating and Ventilating Magazine

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MARCH, 1924

Looking Towards the Future in Heating Practice

Some Unusual Angles of Vision, Based Upon 1923 Progress and 1924 Possibilities of Our Instruments of Service

By Samuel R. Lewis

IN THE first place, let us consider a heating boiler.

A good steam boiler is almost never a good water boiler and a good water boiler hasn't much chance to be a good steam boiler in commercial practice to-day. A good hard-coal boiler is rarely a good boiler for lignite or wood, or even bituminous coal, and a good boiler for the latter is pretty sure to be larger in many particulars than is necessary for good results from anthracite

A modern sectional cast-iron boiler which has part of its upper flue projecting above the water-line into the steam space is subject to just criticism as a steam boiler, because (first) it has a comparatively small steam-liberating area, (second) a restricted heat-absorbing surface and (third) deficient internal circulation of water.

In the conventional sectional boiler of the type having vertical sections, did you ever consider how the upper nipple connection, being at the top, in the steam, is of no value for circulation and do you realize that such a boiler is in reality just a group of separate boilers connected together only at the bottom? There is some sluggish circulation of water in each half of each section or leg, up the hot side and down the cool side, but there is absolutely no chance fo rthe cooler water in the sections most distant from the fire to rub along the hottest sections close to the fire. This kind of boiler is not adapted for operating at overloads. In fact it is customary to derate it about 50%, as a rule.

On the other hand, the most efficient steam power boilers, capable of delivering dry steam at 200% or 300% of rating, without priming and with flue gases well cooled, invariably are refined elaborating as to water ways so as to induce and to promote internal circulation of water, the aim being to cause the entire water content to rub over the hottest surfaces, thus, of course, increasing the rate of transmission by insuring the maximum temperature difference.

Successful boilers of this type invariably have great drums at the water-line to give sufficient area for the steam bubbles to disengage themselves from the clinging water.

I think the characteristics which make good power boilers will also make good heating boilers. Therefore, I predict the next great advance in heating boilers will be along the following lines.

1. Every section will have communication with the next sections, not only at the bottom, but also below and not far below the water-line. The communicating openings between sections will be much larger, and all water ways will be stream-lined and smoothed, to facilitate rapid internal circulation.

2. The steam-liberating area will be about as large as the floor area of the boiler, and the steam space will be furnished with the boiler and assured, rather than guessed at by the erecting fitter, and made out of pipe and fittings in the form of a header.

3. There will be enough water contained within the boiler so that a good share of it may jump into steam when a sudden demand comes, without seriously lowering the water-line. To illustrate this idea, think of a boiler like the illustration shown in Fig. 3, in which withdraw-

I have an ambition to learn how to see engineering facts from unusual angles. I do not wish to imply that I have any hallucinations about being an inventor. I have had a sad experience in that respect. Many years ago, in the night, I remember inventing a scheme whereby a whirling dial in Minneapolis, synchronized with a duplicate in Chicago, could be used for rapid telegraphy. No one told me about it, so I may say that the invention was mine. I found, however, that many others had invented the same thing years before.

Then, a year or so ago, I began to think about and figure on housing over cities and finally presented a paper on the subject before the Illinois Chapter of the American Society of Heating and Ventilating Engineers. The other day, reading H. G. Wells' "A Modern Utopia," I find he describes just such a thing for London.

In connection with my participation in the drafting of the Wisconsin heating and ventilating code, I began to study steam heating boilers and became exceedingly interested in heating surface, internal circulation, water-line, stability, steam-liberating area, etc., in which, as a whole, I felt myself to be something of a pioneer, only to find, this past month, that a man of the name of Kidwell had been thinking and writing about it, all in a very much more satisfactory way, years ahead of me.

My observations here presented are intended to be simply my view of things from a different angle, somewhat as one would see the ordinary building plan at an entirely different angle when made in the form of an isometric drawing.

ing a small amount of water will lower the water-line rapidly, as compared with a boiler, like that shown in Fig. 4, in which a great volume of water removed will lower the water-line only a trifle. The boiler shown in Fig. 3 will prime under sudden demand, while the boiler shown in Fig. 4 will hold steady.

4. Boilers for anthracite coal will have larger grates, more direct firebox surface and less indirect or flue surface, and will be hard-coal boilers and hard-coal boilers only.

Boilers for bituminous coal will have larger combustion spaces, smaller grates and very much more flue surface. There will be arrangements to insure the complete chemical reaction called combustion before the gases impinge on water-cooled surfaces. The fact that we have already developed special oil boilers and special gas boilers, as distinguished from coal boilers, argues for my prediction.

RADIATORS

These are tied up pretty closely with unit heaters and unit ventilators. Long ago someone found that on a cold morning he could heat his otherwise chilly office by getting out the old desk fan, relic of last summer, and turning it on the radiator, wiping the heated air off mechanically, thereby more than doubling the rate of transmission.

Someone else conceived the idea of taking cold air from outside through a casing around the radiator, and calling the result "ventilation." I never had any use for this sort of ventilation. I think no one else, who ever experienced it, has had much use for direct-indirect ventilation.

UNIT VENTILATORS

The unit ventilator pioneers prescribed for and cured many of the faults of the gravity direct-indirect system by applying a fan to the combination. They very cleverly catered to human psychology when they arranged for the air-supply opening to the room below the breathing line where anyone passing could feel the movement and the freshness of the air. They also discovered, and this is vouched for by a leading automatic temperature regulation expert, that with a vertical high-velocity air delivery at the window-stool level, an occasional blast of very cold air would be so diffused and mixed before it impinged on anyone that it was not objectionable to the extent of causing complaints, provided the velocity was kept high.

As has been the case with so many appliances in their original form, the unit ventilator was at first a clumsy and obtrusive fixture, inclined to be noisy and requiring much upkeep expense. It has to take the air directly from outside, with dirt and snow and rain, so that rusting and corrosion are possible and dust is objectionable. No water-pan device as yet devised as an air cleaner appears to be sufficiently effective.

It is to be doubted whether the unit ventilator will drive out the centralized system. The unit ventilator undoubtedly is exceedingly valuable for very many special requirements, as in buildings having rooms used intermittently, certain old buildings, office buildings having many different types of tenants, and lodge and society halls. For large schools where first cost and maintenance cost becomes very high, it may be doubted whether the unit ventilator is the final solution of the problem.

I predict that we will soon have unit ventilators like the following:

1. They will be little wider than radiators and can be buried in the thickness of the walls under windows.

2. They will have several layers of radiation, each separately controlled, so that the present regulation by means of a mixing damper, giving alternate blasts of very hot or very cold air, may be eliminated.

3. They will have dust filters of the viscous fluid type, with unmistakable notice given when the filters need cleaning. A sheet of tangle-foot fly paper would be better as a dust catcher than the present water tank.

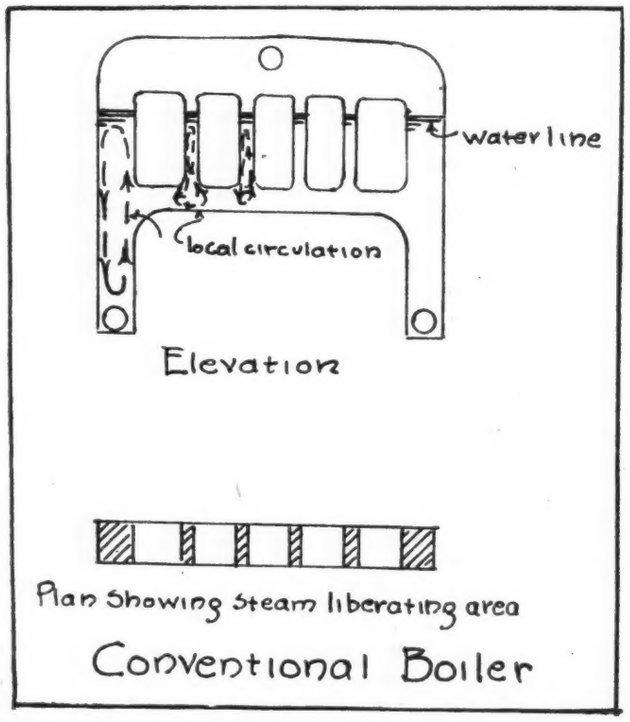


Fig. 1—Steam and Water Circulation in Conventional Type of Heating Boiler

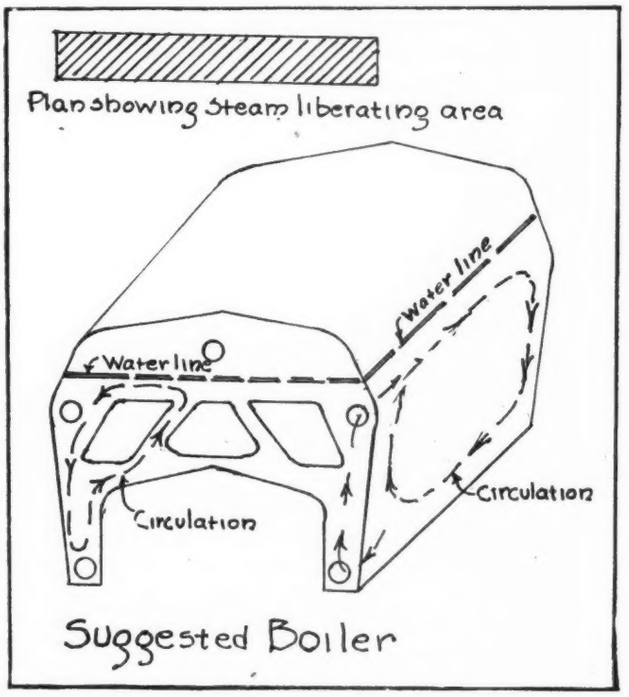


Fig. 2—How Mr. Lewis Would Modify Present Heating Boiler Design

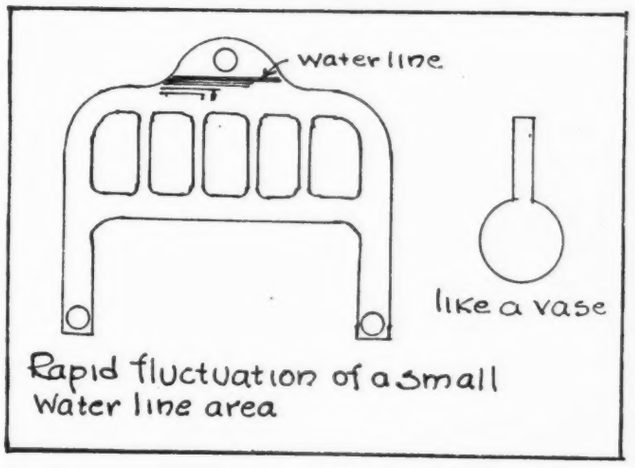


Fig. 3—How Water-Line of Boiler is Rapidly Lowered by Small Water Area

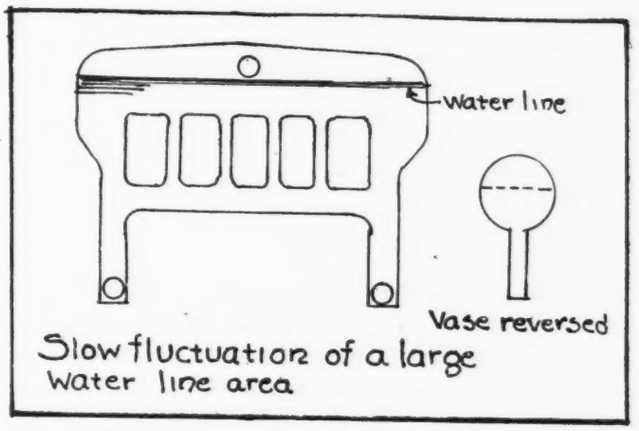


Fig. 4—How Large Water Area Tends to Keep Water-Line Steady

4. They will be built of non-corrosive metal.

5. The fans will be along the lines of the latest reverse-curved blade types, permitting the use of comparatively high speed without objectionable noise.

6. The air supply will be from some more satisfactory point than the window-sill level, perhaps through flues leading down from the attic intakes. There seems no good reason why the air supply cannot be conditioned in a central chamber and then delivered to the units, where there are several units, as in school buildings.

UNIT HEATERS

The unit heater, using recirculated air for heating and creating movement of air within enclosed spaces, is an outstanding achievement. I remember seeing, more than twenty years ago, at Charles City, Iowa, in the Hart-Parr gas engine factory, a series of galvanized-iron wind-mill wheels driving air against circular pipe coils up in the monitors. I was interested and pleased, but did not have the initiative to couple the idea with our modern unit heaters. Doubtless the fundamental physical requirement of most modern unit heaters was missing, for now we draw the cold air from the floor, or discharge the hot air at the floor, while at Charles City it was all overhead.

It is illuminating to see on a sub-zero day, as I have, a great wide, one-story factory, mostly glass as to walls and roof, satisfactorily heated and conditioned throughout its seemingly almost a mile of length by a line of units, having one high-pressure steam line and one vacuum return line—no ducts, no wires, once in a while a neat steel box about 7 ft. high, with fan driven by a steam turbine which exhausts into the heater which condenses the steam.

Such systems surpass direct radiation in operating economy largely because, I believe, they prevent stratification of the hottest air against the cool ceiling, and eliminate the tremendous loss by radiation from hot surfaces placed close to cool outer walls and monitors.

BLAST RADIATION

There is no more striking and common example of blast radiation than we find in the radiators of automobiles. No radiators can get much more arduous service than do those of automobiles, exposed to the most extreme temperatures, with water and mud and rough handling generally. We don't see any automobiles carrying cumbersome cast-iron radiators around for cooling the engine jacket water. They are copper or brass radiators, and they achieve exceedingly high efficiency, and the radiators outlast many other parts of the equipment.

I can see no reason why a copper radiator of the cellular type should not prove exceedingly desirable for heating. Cast-iron or even steel-pipe radiation, particularly for tempering purposes and in connection with air washers, sheds rust in great quantities, and is a prolific source of dust in ventilating systems. There is a strong probability that the automobile type of radiation will overcome this very serious difficulty.

AIR WASHERS

Air washers, as a general proposition, have been much abused. Many of them have been improperly designed and badly installed and poorly maintained. The operating force will persist at times in running the fan without running the washer, getting the ducts very dusty. An operating engineer finds it beneath his dignity to perform scrub woman service in cleaning a washer. Many washers are installed in such cramped quarters that they cannot be cleaned, no matter how willing the engineer may be.

The accumulation of debris in the tank constantly clogs the spray nozzles. An air washer with a hole through the spray, if it leaves some dry eliminator surface, is as bad as a boiler with a hole through the fire. Metal eliminators and casings, under the conditions encountered in modern cities, usually have a very short life. No washer using water, so far developed, seems to remove much soot from the air.

My observation is that it pays to take the cleaning of the washer out of the operating engineer's hands, and make it a routine part of the janitor's or scrub women's daily duty. I try to get them to clean the interior of the washer as thoroughly and as frequently as they clean the white tile floor of the front vestibule.

I have built several washers using masonry for tank and sides, cement-asbestos for top, and ribbed wire glass for eliminators. The glass is set in plowed cypress planks at top and bottom. There need be no fear as to the durability of the bottom plank, which is submerged at all times. For the top we all know how ordinary pine siding on a house lasts many years longer than metal gutters and downspouts. I think cypress here will endure long enough, although I have leanings toward precast light

concrete slabs grooved for the glass. The glass eliminators ought to last indefinitely. They are exceedingly effective as scrubbers, with their vertical saw-tooth edges, and they present a very handsome appearance.

I have not found any practicable way of insuring that the washer shall be operated, and until we do discover some such insurance, I look askance at recirculating schemes depending upon the washer to eliminate odors and dust and to control the humidity.

LOCATION OF INLETS

Considering ventilation of rooms, a spot about 8 ft. up on an interior wall for air supply inlet should no longer be considered the most desirable place. People

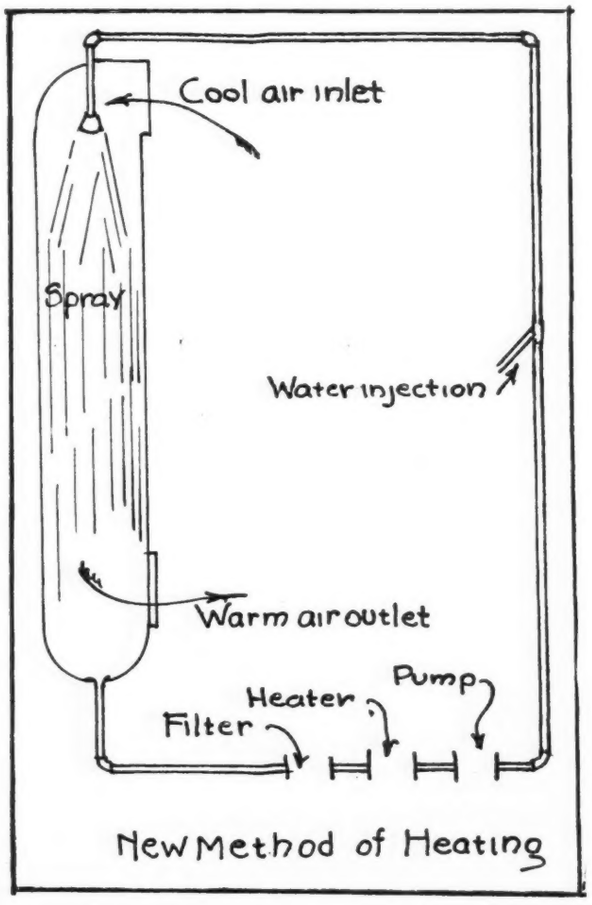


Fig. 5—Scheme of Heating Proposed by Mr. Lewis

wonder what is happening up there, and feel better if they may achieve direct contact with the entering air. A high-up inlet in an interior wall, blowing the air against the cooler surfaces of the room, accentuates the sensible window chill.

Flues placed midway of the side of a room often are as expensive in their obtrusion on valuable floor area as are the unit ventilators at the windows.

It is possible in many buildings economically to deliver the air supply at the window stools or at the floor along the outer wall, using specially-arranged perforated metal baseboards, and to locate the flues for supply and vent in the corners of the rooms.

The diffusion of fresh air with such a scheme is excellent; the window chill is well neutralized; no sanitary rules are violated, and no one gets a draft. It has the same happy reaction as the unit ventilator, in that sharp changes in delivery temperatures can be tolerated.

As evidence of the feeling that the conventional inlets can be improved, the present Detroit practice may be cited, of using six ceiling inlets for each class room, and the Rockford, Illinois method of using a cornucopia-like diffuser at the center of the ceiling.

GROUP HEATING

So far I have stayed within the bounds of ordinary reason. I do not admit yet that it is Utopian for the metropolitan parts, at least, of cities, instead of projecting individual buildings up into the cold where they lose heat in every direction, to cover over with glass the whole territory enclosed within the circle or square of a group of skyscrapers. Figures, however, prove that the cost of such an enclosure will be saved by the reduction of heat loss, other than from individual buildings.

We spend nearly all of our time inside small, only partially ventilated enclosures. Why not abandon retail methods and heat and ventilate the community by wholesale methods? It will be easier to clean the snow from a deserted roof than from a crowded street. There will be no dust to compare with that we meet at present. If modern air conditioning appliances are what we believe them to be, we can promote by wholesale ventilation along these lines, health and comfort far beyond that at present obtainable, by retail ventilation.

A NEW METHOD OF HEATING

Why be limited to the use of boiled water or baked air as a heat conveyor? Nature doesn't use either, but uses blood, a different fluid. Why use dusty, unsightly radiators? Did you ever note the air currents induced by your shower bath, or by the sprays of an air washer?

Instead of boiled water, let us circulate from the boiler, mechanically, if you please, a fluid like good engine oil, but capable of being filtered, non-evaporative, non-odorous and non-corrosive. (Maybe such a thing doesn't exist). Instead of a radiator in each room, let us have a spray head, enclosed in a flue, with inlet and outlet for air from the room. This spray of fluid need not, I think, have much pressure, or be at all noisy. The bottom of the spray chamber can be shaped to receive the fluid without disturbance. The spent fluid flows by gravity back to the filter, then to the pump and boiler for another cycle.

A strong current of air from the ceiling will be drawn into the spray, and will be warmed by a rain, the most effective means of changing air temperature we know of. The air supply, of course, may be drawn from out-of-doors. Any dust in the air will be caught in the fluid.

If any moisture is desired, we simply inject into the fluid at the pump as much water as we need. At the filter on the return journey the fluid will give up its dirt.

The enclosed flue will be very much less unsightly than the best radiator we know of. It will occupy a minimum of floor space, and will utilize the air rights above this minimum floor space, instead of depreciating them, as does a radiator.

Studies in House Humidifying

Pioneer Work of a Canadian Provincial Health Officer in Meeting the Problem of Humidity in the Home

By P. H. Bryce, M. A.

I HAVE been for many years a student and teacher of physical science and a hard-working health officer up in Canada, where the genial sun climbs high for a few short weeks in summer and within a hundred days matures No. 1 hard wheat within the Arctic circle, while at my home on the Grande Riviere of Champlain, the modern Ottawa, I yearly see the sun setting behind the shoulder of the Laurentian hills, advancing on the 21st of June to the point where it draws a line of burnished gold under the middle span of the bridge which spans the Gatineau, thence retiring again, as Wellington did in Spain behind the lines of Torres Vedras, till at this season of the year it is setting at five o'clock behind the pine-clad hill in the park, which is the playground for all Ottawa, both old and young.

There every afternoon and during the moonlit evenings, during the dead of winter, the temperature falls in the still air almost every night below zero and is just comfortable at 15°F for the jersey-coated revellers in winter sports of every sort, from skiing to tobogganning and snowshoeing. This makes everyone able to go home and resist the bad influences of houses, overheated to a temperature of 75°F., but especially with an atmosphere so dry that colds result for those who remain indoors. In fact, evening parties are made popular by the discussions of the changes in the weather and the inevitable bronchitis, which is attributed to it, but which is really due to the condition of the house atmosphere.

DIFFERENCE BETWEEN HOUSE AIR IN WINTER AND SUMMER

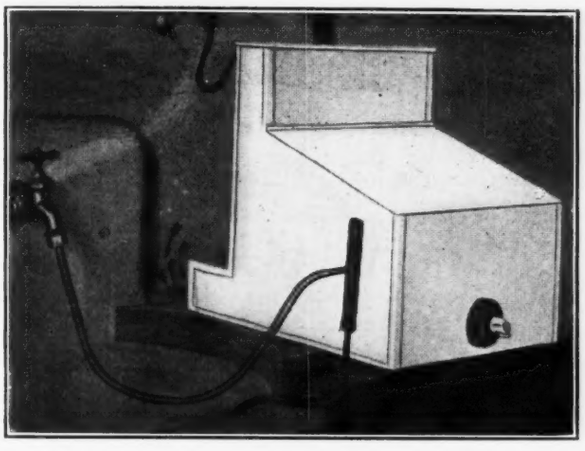
It is hard to realize or have another person realize the difference, which exists between house atmospheres in winter and those in the summer, or indeed the difference between outdoor and indoor air. Outdoor air at zero, sharp and bracing, usually holds in winter some 70% of its total capacity for moisture, which does not amount to more than half a grain of water as vapor; but when this air is introduced into the house and raised to a temperature of 70°F. it has so expanded that it is capable of holding 8 grains per cubic foot, or sixteen times as much as at zero.

Now being a benevolently-intentioned medical health officer, I have for years, day in and day out, consistently preached the need of correcting this indoor winter atmosphere, or what we may call artificial climate, by having enough moisture introduced to prevent sore throats, colds and dry skin and have perhaps produced some results in getting people to put water-pans, at any rate, on radiators and to adopt other temporary means of moisture supply. Most of those appliances requiring attention are usually forgotten; yet when the matter is referred to, the householder seriously protests that he does actually supply moisture, though the furniture still cracks and the seams in the piano regularly open every winter.

A HOME-MADE FRESH AIR HUMIDIFIER

Some time ago the manager of a large business and office staff was discussing matters with the writer at a lunch counter and said: "Can't you do something to make our office right? By three o'clock in the afternoon we are all stupid with the condition of the air." So I had to set about to construct a machine which would supply regularly fresh outer air, both warmed and moistened, and which would be always in gentle movement. This was by and by worked out and a fresh air humidifier constructed, which supplies a measured amount of humidity for any given space from a sick room to a theatre by simply multiplying the heating units.

This humidifier is simply an ordinary electric water heater using from 610 to 2500 watts according to needs. It has an automatic water-level apparatus connected to a pan on top of the heater. The whole is enclosed in a neat galvanized iron casing. There is a duct connection leading to the fresh-air panel of a window. This arrangement allows fresh air to come in and ascend with the steam to the hallway. There it is distributed throughout the whole house area. A 2500-watt heater, with a duct leading to the outside air, is capable of supplying 20,000 cu. ft. of fresh humidified air per hour, as well as maintaining the proper temperature. By duplicating or quadrupling these units, almost any practical requirement can be met.



Humidifier For Home Use Designed by the Author

THE HUMIDIFYING OF A TYPICAL HOME

But my romance has to do with the home of a returned soldier, who organized his regiment, took it to France, was three years in the trenches, beloved of his men, came home unscathed and in the affluence of a lumber king determined to enjoy properly a life of peace in his native town, the Canadian capital. Having lived through frost and mud in Flanders he did not think

Palm Beach the proper solution of life in winter for a native-born Canadian.

He had already an attractive home, a cultured wife with three children to make the home complete and happy, with every convenience that wealth could give from oil-heated furnaces, even with an evaporator attached and already supplying a certain amount of moisture to the house air.

But he had been reading my article on "Humidity," had learned that normal air on a bright day, whether in winter or summer, holds usually nearly 70% of its capacity for moisture, while his dry and wet-bulb thermometer in the hall registered only from 25% to 30% of humidity. The colonel was disturbed; he realized that the children, driven to school in the motor, lived there for five hours in a close, dry atmosphere. They were brought home weary, and even the comfortable house did not seem to supply them with the energy that they should have. He asked what could be the matter and finding no answer he inquired of the "air doctor."

So the "air doctor" was called in to diagnose the malady. At first sight the house seemed perfect; there were large rooms with oak floors, rugs rolled up in the morning and taken into the back passage for treatment with the electric duster, the walls were beautiful, cream-tinted, with no heavy hangings, and having an abundance of light from large south windows. The furnace room was next visited and everything there found in perfect order, with an evaporator supplying its drip, drip to a casting heated in the furnace.

Inquiry began. "How much water is evaporated hourly?" he was asked, and the answer was that he didn't know. "You can see for yourself," he stated, "the apparatus works just as well as when the contractor put in the costly affair." Then I proposed that we measure it and found that it was dropping about 3 oz. every six minutes or supplying two pints of evaporation in an hour to the splendid mansion which contained some 100,000 cu. ft. of air.

But the hygrometer or moisture-measurer in the hall had already told us that there was on this zero morning only 28% of relative humidity or moisture in the air. We had discovered the first fact. The next observation to be made was that there was no regular inlet supplying outer fresh air to the house in any quantity.

Of course there was in such a large house plenty of oxygen for every one; but it was contained in a great enclosed walled-in space, having double windows and supplied all the conditions of Tennyson's "Island Valley of Avilion:"

> "Where falls no hail or rain or any snow
> Nor ever wind blows loudly."

This was the second fact, so I proceeded to make a calculation, which was by no means as easy as it might seem at first. Had I been dealing simply with outdoor air at zero, I could readily have estimated how much moisture was required to humidify 100,000 cu. ft. of air; but the trouble was that we were already having supplied a certain percentage through evaporation, so I am going to risk telling the reader how the sum worked out.

WHAT THE ACTUAL HUMIDITY REQUIREMENTS WERE IN THIS HOUSE

When outside air at zero is warmed to 70°F. we have, as already stated, increased its capacity to hold moisture from ½ grain per cu. ft. to 8 grains at 70°F. Now allowing for the moisture always present in the air, it is plain that if we added some 4 grains, or half of 8, we would have a house moisture with from 50% to 55% of humidity. But we had already in this air some 28% of moisture, or about half of what was required, so it seemed simple to say that if outer air required 4 grains to supply a proper humidity, 2 grains added to what was already present would be enough to bring the house humidity up to a standard of 55%.

So it is obvious that 2 grains would have to be added to each of the 100,000 cu. ft. of house air, or nearly 3 gal. of water would have to be supplied every hour.

With the automatic humidifier referred to it was easy to do this. All that was necessary was to utilize enough electricity under one or more shallow pans, and introduce fresh air in quantity to be drawn into the house by the steam as it rose from the pans over the electric heater. This was done by constructing an apparatus which was placed near a cellar window, where a direct connection was made with the outer air by removing a window pane and bringing in air through a galvanized-iron duct to the apparatus. As the water supply to the pan over the heater is automatic and is kept at a constant level by a simple apparatus, all that was necessary was to bring the warmed moist air, to the extent of some 50,000 cu. ft. per hour, into the hall by a direct duct leading to a register in the floor. Thence by the law of "diffusion of gases" the moisture would soon find itself in the farthest attic room of the house.

The calculation made was proved to be correct and the humidity rose in the house to exactly the required percentage and the amount of fresh air brought in was close to that which was already estimated. This further served the purpose of keeping the whole house air in gentle circulation and creating an air pressure from within outwards, which, with the heat supplied by the electricity, at once lessened the required amount of furnace fuel, and by reducing the temperature in the house from 75°F. to 66°F. we had secured economy in fuel, improved health and general happiness throughout the home.

While satisfaction may be attained with an automatic humidifier supplied by electricity, where a single unit can be attached to the ordinary house fixture and supply enough moisture for at least 6,000 cu. ft., yet where electricity is more costly it is quite possible to supply the humidity by either utilizing the furnace or better, by a separate gas heater.

WHY COLD AIR IS THE BEST AIR TO BREATHE

People do not realize that what makes them warm and the furnace warm is abundance of condensed oxygen, found best in air at zero, since it consumes the fuel which manufactures the body heat, promotes digestion and general metabolism and increases the appetite, as has long been proved by the fresh air life at Saranac in the Adirondacks. When people come to know more about what fresh cold air can do in assisting nutrition, and, further, that house atmospheres in winter can be made almost as natural as the perfect outer air, then the beauties of the Northern pine and fir trees in forest and park and the outdoor life of skating, skiing and snow-shoeing will receive their proper appreciation as the best means to cultivate health.

Aerology for Amateurs and Others

The Evolution of Modern Ventilation and its Effect on Present and Future Practice

By E. Vernon Hill

Previous articles in this series are as follows: January, 1923, Historical Sketch; February, 1923, Health and Comfort Factors; March, 1923, The Manufacture and Use of Thermometers; April, 1923, Test Methods; May, 1923, Air Dust; September, 1923, Classification of Test Methods for Dust Determinations; October, 1923, Discussion of Test Methods for Dust Determinations; November, 1923, Odors; December, 1923, CO_2; Air Distribution, January, 1924.

XI—Measuring Air Velocities

IT IS not our intention under the present heading to go into all of the known methods, technical and otherwise, of measuring the velocity of the air in a duct, at the face of the register, etc., but rather to outline field conditions, together with some experimental devices that may be of interest to the reader.

1. ANEMOMETER

The instrument most commonly used for determining air velocity is the anemometer, a common type of which is illustrated. This instrument consists of a revolving wheel carrying angular vanes, usually eight in number. The shaft of the wheel is connected by suitable gears to indicating hands on the face of the instrument, which is not particularly accurate, yet its general utility and the fact that a small amount of training and experience is necessary in its use, makes it the instrument most commonly selected by the average user.

There is sometimes a wide divergence in readings obtained by two persons with the same instrument and under practically indentical conditions. This should not always be attributed to inherent defects in the anemometer, but rather to ignorance or carelessness in its use. If care and judgment are exercised and readings carefully checked, it will be found that the anemometer can be relied upon where extreme accuracy is not essential. There are certain requisites in the use of the instrument that must be borne in mind:

(a) It must be in good repair and properly calibrated. The jewelled bearings at the end of the shaft do not stand rough usage and frequently become cracked or broken. An instrument that appears sluggish when held in an air current should be carefully examined. Broken bearings or other serious defects can usually be detected if the instrument is held close to the ear while in motion. Any grating or clicking sound at once calls for careful examination. The anemometer should be calibrated by someone competent to do this at least once every six months, and the calibration curve or the correction factors always carried with the instrument and referred to after readings are made.

(b) A second requisite is that readings be accurately timed. For this purpose a stop watch is desirable, though not essential. If a second person is present when readings are being made, he should be pressed into service for timing the readings. We find it convenient to use the words, "Get ready—GO!" when the operator throws the anemometer into gear, and "Get ready—STOP!" when the time interval has been completed.

The person taking the reading should hold the anemometer in the air current a sufficient length of time before throwing the gear lever to be sure the vane is revolving at the speed the air current will produce. Readings where accuracy is essential should be for one minute.

(c) A third requisite for accurate results is that the proper method be employed in taking the readings. In making tests at a register face, for example, the method of slowly moving the anemometer across the face of the register is mentioned only to be condemned. Readings will not be accurate except in those cases where the velocity over the register face is uniform.

In taking readings where the velocity varies over different areas of the register, it can be readily seen that by moving the instrument slowly across areas of high velocity the vane will revolve at a correspondingly high speed and will continue to revolve at a higher rate than it should while passing the next area where the velocity is low. This usually gives a higher average velocity than conditions warrant. It might be logically argued that in passing from a low to a high velocity, the speed of the

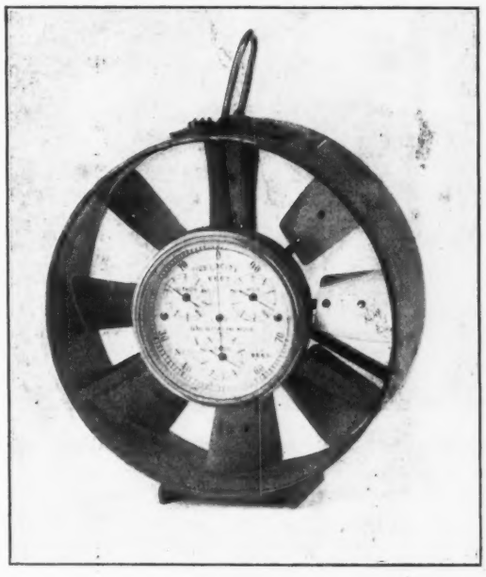


Fig. 33—Common Type of Anemometer

vane would be correspondingly retarded, compensating in this way for the high readings previously mentioned. There is, however, a human element in the problem that cannot be overlooked.

The individual holding the instrument, even though he be trained in its use, has what appears to be an uncontrollable tendency to favor areas of high velocity and to quickly pass low velocity areas where the vanes do not spin to his entire satisfaction. We invariably find, therefore, that readings taken under these conditions give a higher averaged velocity than is warranted.

PROPER METHOD OF TAKING READINGS

The proper method of taking readings is to divide the face of the register into equal rectangular areas of approximately 6 in. and take one-minute readings at the center of each area. If the register is large, the area can be increased in proportion. But if the register is approximately 18 in. x 24 in. or larger, not less than twelve areas should be outlined and twelve readings taken. The total velocity as shown by the anemometer, divided by the total number of minutes, gives the average velocity. This, times the net free area of the register, gives the volume of air in cubic feet per minute.

It sometimes happens that portions of the register deliver no air whatever, due to the short curvature of the duct as it approaches the register face, or to the improper design or installation of air splits, diffusers, etc. It is always good practice to explore the register face

Fig. 34—Proper Method of Taking Readings at Register Face

before laying out areas for anemometer readings. A strip of rather stiff writing paper cut about 8 in. long and 2 in. wide is a convenient device for this purpose. The strip of paper is held by one end between the thumb and finger and passed over the register face. This exploration will locate areas where no air is flowing. These areas should then be excluded from the portion of the register over which test areas are laid out and readings taken.

The American Society of Heating and Ventilating Engineers appointed a committee some years ago to formulate a standard method for using the anemometer. Its report, under date of January 23, 1913, is as follows:

"1. The opening should be divided into equal rectangular areas, no side of which shall be over 10 in. long, except where this would require more than ten readings, in which case the opening should be divided into twelve equal areas.

"2. Readings are to be taken in every case in the center of each area.

"3. Readings are to be of one-half minute duration, the anemometer being held at the register face in the plane of the opening.

"4. Where diffusers are used, the total area is to be computed on the basis of the periphery of the diffuser.

"5. The average of the readings is to be considered as the average velocity of the opening. Where negative velocities are found, they are to be deducted in arriving at the average velocity.

"6. In computing volume, the net area of the opening is to be taken, the volume to be considered as the product of the average velocity, times the net area of the opening. In case the anemometer is held 2 in. from the register face, no deduction should be made for the registered mesh."

Fig. 35—Method of Locating Areas Having no Air Delivery

The recommendation of this committee, although ten years old, represents, with few exceptions, the best practice at the present time. Paragraph No. 6 of its report, however, requires some discussion. There is a wide variation in the types of registers; plain metal register faces are becoming quite common with uniform rectangular openings. Where tests are made over register faces of this kind, experiences has demonstrated that the gross area of the same, times the average velocity, gives the closest result in arriving at the total. By gross area is meant the total area of the register face proper, where air is passing.

The committee recommends that the anemometer be held 2 in. from the register face. This gives excellent results if the velocity through the register is not low, not less than 400 ft., per minute. In case the velocity is less than this, the anemometer should be held not more than 1 in. from the face of the register.

In ornamental types where the register face is made up of school or other more or less artistic devices, a reading at the face is little indication of the true velocity and there is no way of determining the net area. In cases of this kind, the only solution is to make a box of heavy cardboard or wood, of the same size as the register and not less than 18 in. deep. The box is closely approximated to the register face and the readings taken at the box outlet.

In taking readings at an exhaust register, the same method in general is used as in taking readings at a supply register, and the same precautions are to be observed.

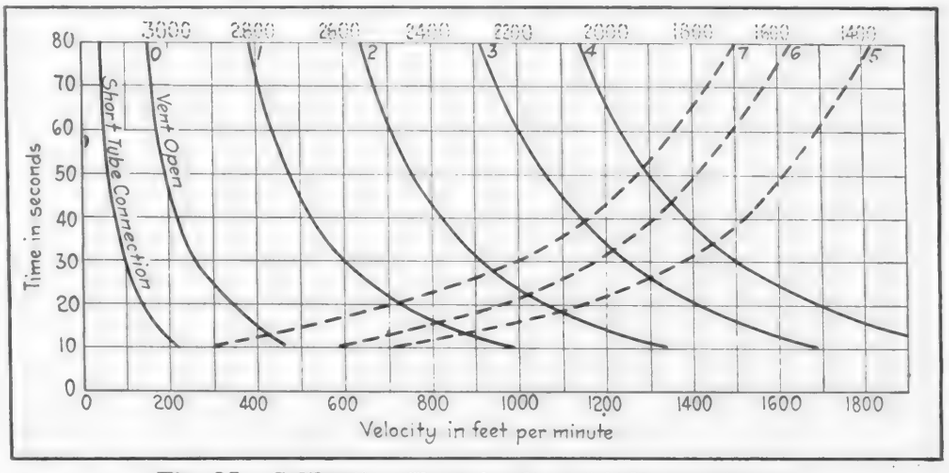


Fig. 37—Calibration Chart for Use with Kopnaerimeter

In taking exhaust readings, however, the anemometer is usually applied directly against the register face, with the face of the instrument outward.

In taking readings in tunnels or a large duct, where the investigator must enter the same, due consideration must be given to the fact that his body acts to constrict the diameter of the tunnel at the point, increasing the flow of air about him. The importance of the factor depends upon the area of the passageway and velocity of the air through same. In making tests of this character, they should be carefully checked by readings at the OUTLET or INLET, or some other part of the system if this is possible.

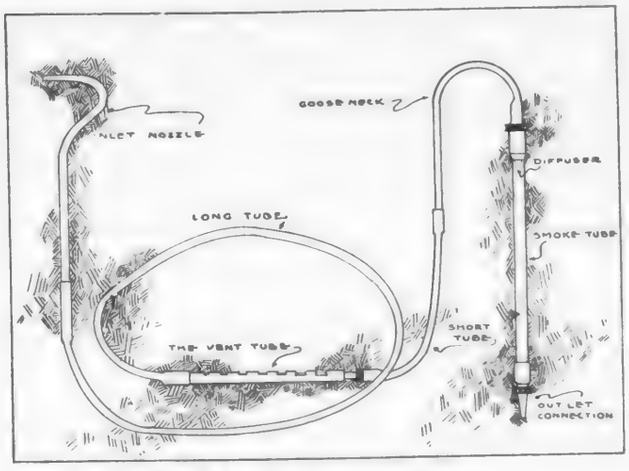


Fig. 36—The Kopnaerimeter

2. KOPNAERIMETER

In experimenting with smoke tubes in an endeavor to develop an instrument for the studying and tracing of air currents in a room, the writer found a surprising uniformity in the displacement of a column of tobacco smoke in the vertical glass tube when air was allowed to enter at the top. An instrument for measuring any air velocity was developed from this experiment and named the "Kopnaerimeter," or smoke air meter. The principle on which it operates is the displacement of smoke in a glass tube by the incoming air through a fixed orifice. The rate of flow, and consequently of smoke displacements, depends upon the velocity of the current of air to be measured.

The instrument consists of a glass tube (smoke tube) and a metal inlet nozzle. These two principal parts of the device are connected by 36¼ in. of rubber tubing. The tubing is divided into two portions, the longer one which is always connected to the inlet nozzle, being 27½ in. long and the shorter piece connected to the smoke tube, being 7¾ in. long. Between the two pieces of tubing the "vent" is inserted. This consists of two metal tubes, one sliding into the other. The outer tube is provided with graduated slots, seven in number. Withdrawing the inner tube opens the vents successively and allows readings of higher velocity to be taken, without disturbing the meniscus of the smoke column.

The vent tube is always inserted with the smallest slot nearest the inlet tube. The upper end of the smoke tube is provided with a gooseneck, which serves to hold the instrument when in use and to form the connection between the smoke tube and the inlet nozzle. The end of the gooseneck which is inserted in the smoke tube is provided with a diffuser, which prevents the incoming air from disturbing the meniscus of the smoke column. It also serves to hold the rubber stopper in place.

DIRECTIONS FOR USING KOPNAERIMETER

In using the instrument, the smoke tube is held suspended by the gooseneck by the little finger of the left hand. The inlet nozzle is held accurately facing the air flow by the right hand. (See Fig. 38). A watch, preferably a stop-watch is held also in the left hand.

The instrument is filled with smoke by removing the gooseneck connection and blowing smoke from a cigar or cigarette into the tube through the outlet connection. During this operation, the tube is held in the left hand, with the index finger pressed lightly against the distal opening of the tube, thus allowing the excess of smoke to escape and serving to close the tube when it is thoroughly filled with dense smoke. After the tube is filled

with dense smoke, the finger is removed and the gooseneck connection inserted. If the foregoing operation is carefully performed the tube will be completely filled with dense smoke. By next blowing gently against the inlet nozzle, the upper end of the smoke column (the meniscus) will appear and the instrument is then ready for making the test.

The tube in the left hand must be entirely out of the air flow, as any appreciable air currents across the outlet connection of the smoke tube will affect the accuracy of the results. When the inlet nozzle is held in the air currents, the smoke in the tube will descend and the tube finally be entirely cleared. The time in seconds must be taken until the smoke meniscus reaches the level of the top of the outlet connection.

Fig. 38—Making an Air Test with a Kopnaerimeter

If the velocity of the air is high, the meniscus will be disturbed, usually funnel-shaped and its descent is timed with difficulty. In this event, the vent tube is opened two, three or more slots, until the smoke meniscus descends evenly and during the proper time interval. A little practice and experience enables the user to determine readily the proper adjustment of the vent tube for the air velocity being measured. After the time required for the meniscus to descend has been determined, the calibration chart which accompanies the instrument is referred to and the velocity in feet per minute is determined.

It will be observed that the velocities below 1,500 or 1,600 ft. per minute are read on the curves starting from the left-hand side of the chart. Velocities above these are shown on the reversed curve by means of the lower scale.

In measuring velocities below 200 ft. per minute, remove the tubing from the gooseneck, remove the diffuser and invert the smoke tube, the inlet nozzle is then connected to the outlet of the smoke tube by the short rubber tubing. This reduces the friction to a minimum and makes it possible to obtain accurate readings as low as 30 ft. per minute.

1. See that the instrument is always connected and operated in accordance with the instructions, as it is calibrated as described and any other method of connection or using will not give accurate results.

2. See that the smoke tube and connections are clean. Never blow smoke through the tubing, the inlet nozzle or the diffuser. Always remove the gooseneck when filling the tube, as smoke will foul the small holes in the diffuser and thus render the readings inaccurate.

3. Do not change the size or length of the tubing supplied with the instrument. When new tubing is needed, it can be replaced at an insignificant expense.

New Type of Heat-Insulating Wall Construction.

A new type of insulated wall construction now in use in Germany and which is the result of many years of research, is described in a recent report of the British Building Research Board, which is an adjunct to the British Department of Scientific and Industrial Research. This organization is devoted to research work on building materials and methods of construction. It has recently carried out a series of experiments on the transmission of heat through walls, concrete and plaster, the results of which are included in its report. While, in general, rather too technical to be available for practical men engaged in building operations, there is yet a considerable amount of information which will be found useful.

The insulating wall construction developed in Germany, as described in the report, is built in accordance with the following principles:

Air being a poor conductor of heat will nevertheless lose its low conductivity when it becomes moist or when in motion. The latter is the more important consideration because the transference of heat from a surface is greater the quicker the air passes over it. Thus, if the air within an air space can be kept still, it will possess relatively a high insulating value. Within the air space of a wall circulation of air depends on the difference in the temperature of the enclosing walls, the height of the intervening space and its breadth. If the space happens to be very narrow, currents of air from different directions will obstruct each other and produce air eddies, thus preventing the formation of a continuous current. If there is a large air space with partitions in it, there will be graduations of temperature progressively lower from the hot to the cold side, and the general circulation of air is much less than it would be if there were no partitions.

If horizontal divisions are made, it lessens the heights of the air columns of different densities through the partitioned space, and impedes the circulation of the air still further, thus reducing the heat conductivity of the air. The partitions will also reduce the transmission of heat by reflecting it and the more of this reflectivity there is in a wall, the less chance will there be for the heat to get through and be dissipated on the far side.

In actual practice this theory is applied in building walls within which the air space is subdivided many times and the vertical partitions are considered deflectors of the heat to prevent radiation. The materials used in the construction of this wall are all water-proofed, with the idea of keeping the air as dry as possible. The partitions which are used for dividing the air space are of thin wood, first treated with a preservative and then protected on the outside with an insulating pasteboard.

On the inside of the wall there is usually a structural frame of reinforced concrete, wood or steel. Thus the inner surface may be followed by six partitions, then a partition of special plaster, then six more partitions, and then the outside wall surface, in a typical house wall. The builder, of course, must take great care to insulate thoroughly the points between the supports and the outside surface of the walls in order to insure that where the supports are placed, the differences in temperature between the faces will be the same as it is elsewhere.

"Effective Temperatures" or "Equal Comfort" Lines

A Review of the Data Obtained to Date Which Show How Far the Basis for Comfortable Air Conditions Depends on Both Dry-Bulb and Wet-Bulb Temperatures and Air Movement

1—"Effective Temperatures" for Still Air Conditions

By F. C. Houghten, C. P. Yaglaglou** and R. R. Sayers*

The accompanying report is one which has just been published by the Bureau of Mines, Department of the Interior. As will be seen, it is based upon experiments made by the Research Laboratory of the American Society of Heating and Ventilating Engineers, in Pittsburgh, to determine the relative feeling of warmth experienced by men in atmospheres of various degrees of temperature and humidity. The results, it will be noted, are for still air only and are given in a little different form from that of the A. S. H. & V. E. report (presented at the 1923 annual meeting and supplemented by additional data at the 1923 semi-annual meeting).

As the authors state, the results of an investigation to determine the relative feeling of warmth a person will experience for all combinations of temperature and humidity are of value in helping to systematize the results obtained in the study of the effects of high temperature on the health, comfort and efficiency of men. These results will also be of value in predicting beforehand just what can be expected for any given atmospheric condition, as well as to indicate what improvement will result from any proposed artificial air conditions—that is, special ventilation.

In a subsequent issue will be presented data obtained by the same investigators and presented at the recent meeting of the American Society of Heating and Ventilating Engineers, on the cooling effect on human beings produced by various air velocities, ranging from 150 ft. to 500 ft. per minute.

HUMAN comfort or discomfort depends largely upon body temperature, and therefore upon the relation between the rate of heat production within and dissipation from the body. In order to maintain a constant body temperature, the loss of heat must equal the heat produced. It is therefore apparent that any interference with the elimination of heat from the body is accompanied by a rise in temperature and a feeling of discomfort.

There are three principal factors affecting loss of body heat, namely—(1) temperature, (2) humidity, and (3) air motion.

As the temperature of the air and surrounding objects rises, the loss of heat by convection and radiation decreases. When the temperature reaches that of the body, the loss by radiation and convection ceases. Finally, as the air temperature exceeds that of the body, heat passes from the air to the body.

If on the other hand, the relative humidity is increased, the heat loss by evaporation decreases. If, while the dry-bulb temperature increases, the wet-bulb temperature decreases sufficiently, the increase in loss of heat by evaporation may be made equal to the decrease in loss of heat by radiation and convection, resulting in no change in body temperature or comfort.

From these premises it is concluded that there must necessarily exist certain combinations of temperatures and humidities which will produce the same total body heat, loss by radiation, convection, and evaporation; and therefore the same feeling of comfort or discomfort. Lines passing through such air conditions, plotted in the form of a psychrometric chart, may be called equal comfort or effective temperature lines.

EQUIPMENT

The Reasearch Laboratory at Pittsburgh is well equipped for conducting this work. There are two psychrometric rooms 8 by 17 by 10 ft., each insulated with 4 in. of cork board, besides the regular building construction, and plastered on the inside. The temperature, humidity, and air motion in each of these rooms can be controlled independently of each other. The air-conditioning apparatus is in an adjoining room, and includes an air-washer, humidifier, dehumidifier, heating coils, etc. The plan of these rooms, with the position of air-conditioning equipment and other accessories, is shown in Fig. 1.

Recirculated air, air from the corridors of the building, or outside air, or any combination of these three, is drawn through a tower of sprays, which acts as air-washer and humidifier or demumidifier, depending upon the temperature of the spray water. The air then passes through a fan, then over heaters, and divides into two ducts supplying the two rooms. Some of the air can be made to by-pass the heaters into the duct, leading to the first room.

The ducts terminate in plenum chambers, 5 by 17 by 3 ft., at the top of each room. In the stream of air leaving the duct is placed a water spray and steam jet. A 60-sq. ft. radiator is placed in such a way that the incoming air passes over it. Each plenum chamber is equipped with refrigerating coils.

The air enters the rooms from the plenum chambers through a large number of small holes widely distributed. The temperature of the water used to wash and humidify or dehumidify the air supplied to the rooms is thermostatically controlled by automatic diaphragm valves, which admit either steam or water from a cooling tank. A thermostat in each room controls either the steam supplied to the main heaters or that supplied to the small radiators in the plenum chambers.

The spray nozzle at the entrance to the plenum chamber in the first room is controlled by a hygrostat. The amount of air admitted to either room is controlled by a hygrostat. The amount of air admitted to either room is controlled by dampers. This arrangement gives flex-

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ible and independent control of all the factors entering into the air conditions of either room.

The range of temperature and humidities attainable is considerable, but is limited by the capacity of the heaters and ammonia compressor. Saturated temperatures, such as those which a human being can withstand for only a few minutes, can be obtained without difficulty. Low humidities with high temperatures are limited, however, by reason of the fact that the air before passing over the heaters must be cooled to the dew-point of the desired condition. With re-circulated air it is not possible to obtain a very low humidity with high temperature. However, by taking outside air on a cold day, and then further cooling it in the dehumidifier, a low dew-point can be reached, making possible very low humidities at high temperatures.

METHOD OF CONDUCTING TESTS

In conducting tests to determine the equal comfort lines, the atmospheric conditions in the second psychometric room are accurately maintained at a relatively high dry-bulb temperature and low relative humidity. The atmospheric condition of the first psychometric room is brought to a lower dry-bulb temperature and higher relative humidity, such that observers passing from one room to the other decide that it feels slightly cooler than the second room.

The dry or wet-bulb temperature, or both, of the first chamber are then allowed to rise slowly while the observers pass back and forth from one chamber to the other, each time recording their judgment as to the relative feeling of warmth of the two conditions. As the temperature or humidity of the first chamber increases, a point is reached where the observers judge that the sense of warmth in the two chambers is the same. As the temperature or humidity of the first chamber continues to rise, a point is reached where the first chamber is the warmer of the two, although its dry-bulb temperature in some instances may be as much as 50° lower than that of the second room. The change in wet-bulb or dry-bulb temperature of the first room, from the point where the observers agree that it is the cooler of the two, to the point where they agree that it is the warmer of the two, seldom exceeds one degree—in fact, it is usually considerably less than one degree.

All tests were checked by starting with the first chamber warmer than the second, and reversing the process. Table 1 shows the results of an actual test in which three observers recorded their independent feelings. This was one of 440 tests made to determine equal comfort lines. Conditions are represented by points D and E on the Psychrometric Chart (Fig. 4).

TABLE 1—TESTS TO DETERMINE EQUAL COMFORT LINES

First room Dry-bulb	First room Wet-bulb	Second room Dry-bulb	Second room Wet-bulb	Observers' feelings in reference to first room A	B	C
Deg. F.	Deg. F.	Deg. F.	Deg. F.			
95.8	87.4	115.0	82.8	Cooler	Decidedly cooler	Cooler
96.2	87.6	115.0	82.8	do	Cooler	do
96.6	87.9	115.0	82:7	Slightly cooler	do	Slightly cooler
96.8	88.1	115.0	82.8	do	Slightly cooler	do
96.9	88.2	115.1	82.8	Same	do	do
97.0	88.6	115.0	82.8	do	Same	Same
97.3	88.8	115.0	82.8	Slightly warmer	Slightly warmer	do
97.6	89.0	115.0	82.8	do	do	Slightly warmer
98.0	89.3	115.1	82.7	do	do	Warmer
98.8	89.5	115.2	82.8	Decidedly warmer	Decidedly warmer	Decidedly warmer

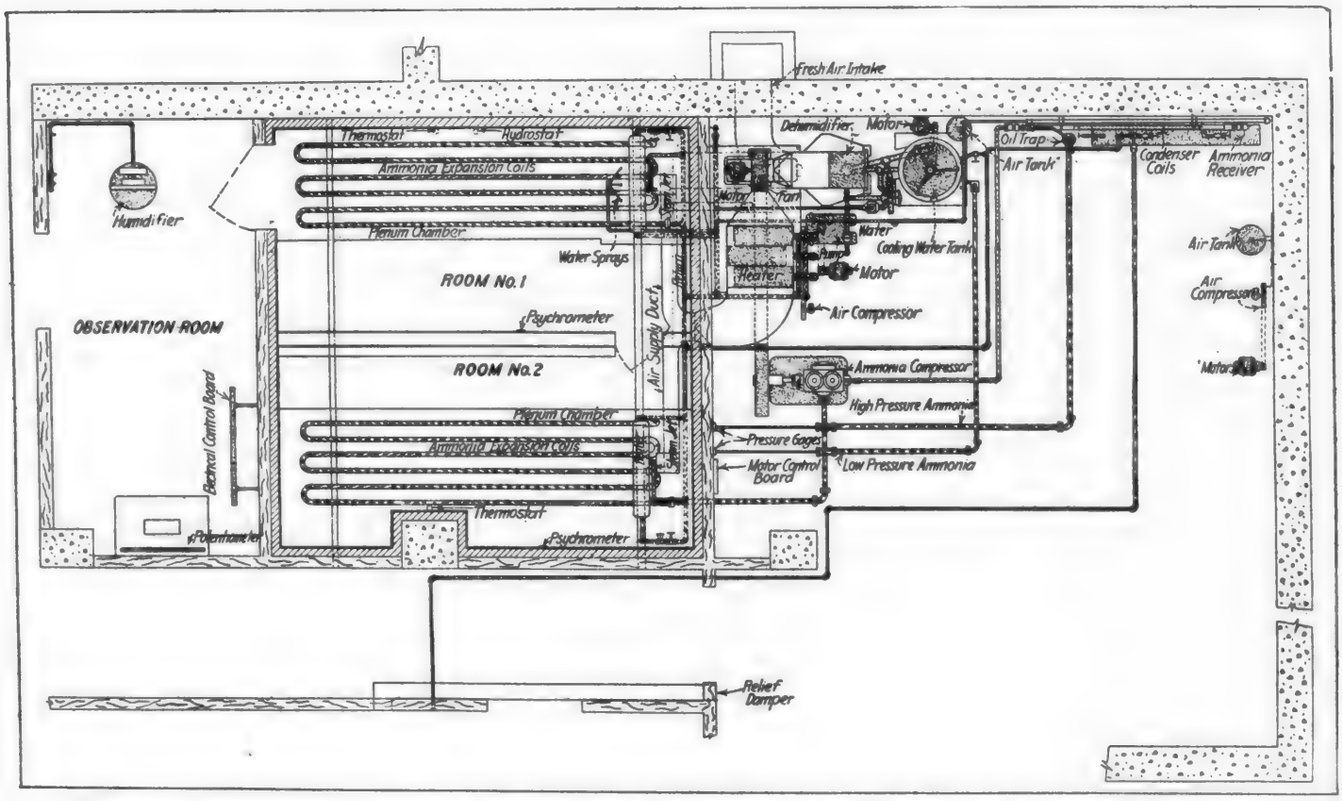


Fig. 1—Psychrometric Chamber and Auxiliary Equipment at A. S. H. and V. E. Research Laboratory

It will be seen that there is a difference of only 0.3° dry-bulb and 0.9° wet-bulb from the point where the observers agreed that the first room was cooler to the point where they agreed that it was the warmer of the two.

DATA AND RESULTS

A standard psychrometric chart with equal comfort or effective temperature lines superimposed is shown in Fig. 2. This chart was first prepared by Carrier.* The dry-bulb temperature is plotted as abscissa, and grains of moisture per pound of dry air as ordinates. The wet-bulb temperature for any dry-bulb temperature with given moisture content is given by a series of practically parallel oblique lines. Relative humidity for any dry-bulb temperature with given moisture content is given by a series of similarly curved lines.

The equal comfort or effective temperature lines, which are the subject of this paper, are given by a series of straight, but not parallel lines.

EXAMPLE OF USE OF CHART

As an example in the use of the chart, assume an atmospheric condition which gives a dry-bulb temperature of 85° and a wet-bulb temperature of 75°. Following the horizontal line through the intersection of the 85° dry-bulb and the 75° wet-bulb line to the left to its intersection with the *y* axis, it is found that the air contains 112 grains of moisture per pound of dry air. The intersection of this same horizontal line with the saturation, or 100% relative humidity, curves gives 70.5° as the dew-point of the given condition.

From the relative humidity lines we also see that the relative humidity for this condition is 63%. Following the effective temperature line passing through this point upward and to the left, we find that the effective temperature for the given condition is 78.5°. This means that the given condition would give the same sense of warmth as 78.5° dry-bulb and 100% relative humidity. It also gives a person the same feeling of warmth as 107° dry bulb with perfectly dry air, or 0% relative humidity, as found by following the same effective temperature line downward and to the right to its intersection with the 0% relative humidity line.

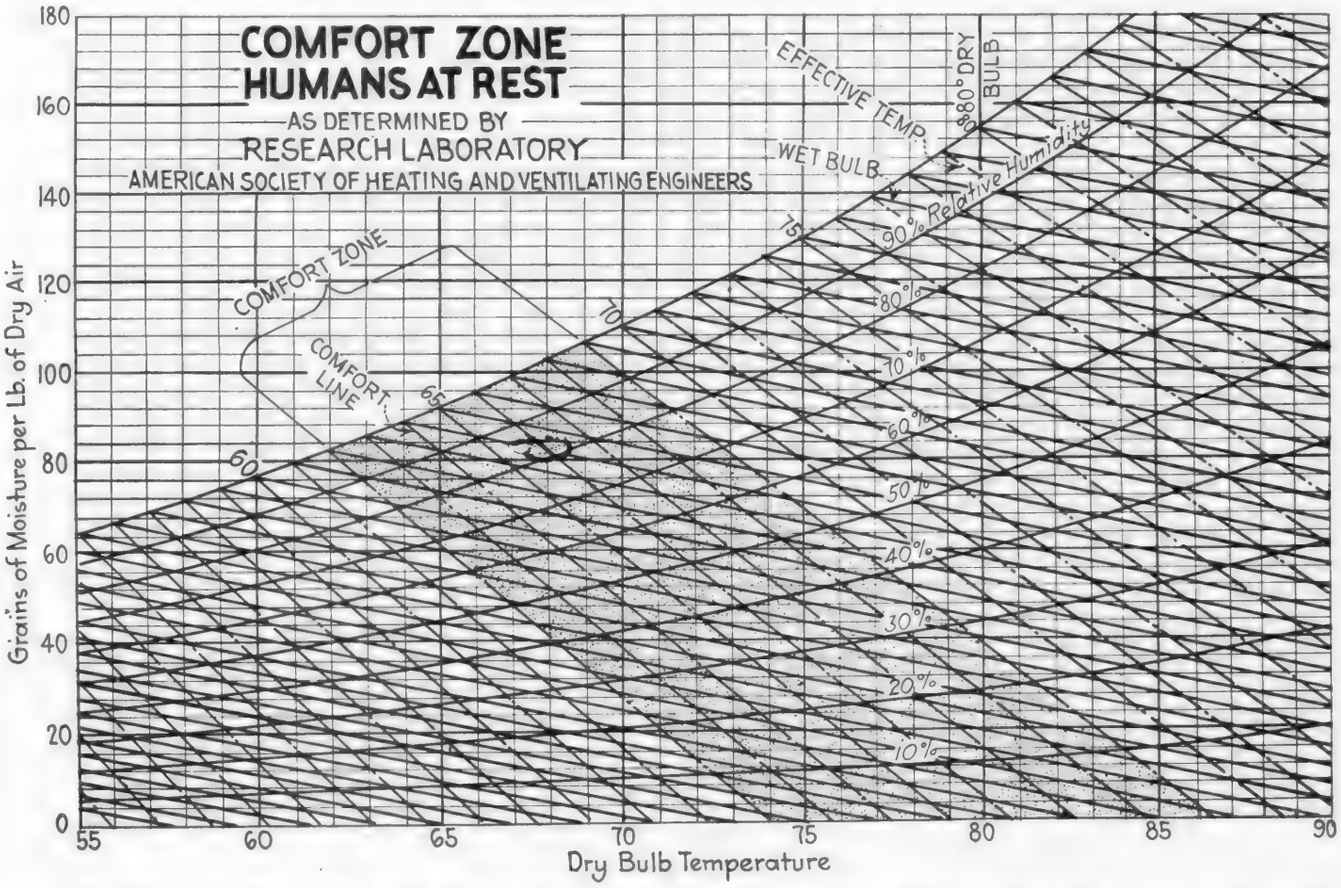


Fig. 2—Psychrometric Chart with "Equal Comfort" Lines or "Effective Temperatures" for Still Air Conditions (Condensed)

It will be seen that the effective temperature lines form a series which are not parallel among themselves but approach being parallel to the wet-bulb lines at high temperatures, and dry-bulb lines at the freezing temperature, which is in accordance with expectations. At high temperatures a person perspires freely, and the skin approaches the condition of a perfect wet bulb, while at low temperatures the surface of the body is relatively dry, and therefore is little cooled by evaporation. At low temperatures, moisture in the air causes clothing to become damp and therefore a better conductor of heat.

* Carrier, W. H., Rational psychrometric formula: Trans. Am. Soc. Mech. Eng., vol. 33, 1911, p. 1005.

The equal-comfort line passing through 67° dew point intersects the same number of dry and wet-bulb lines. It follows, therefore, that for all points on this equal-comfort line, dry-bulb and wet-bulb temperature are of equal importance in determining comfort. Below this equal-comfort line the dry-bulb temperature is of greater importance, while above this line the wet-bulb temperature is the more important factor in determining comfort.

At 132° (saturation temperature) the angle between wet-bulb and equal-comfort line, found by extrapolation, becomes zero. Therefore, at this temperature the wet-bulb lines are also equal-comfort lines; or, in other words, comfort depends upon wet-bulb temperature alone.

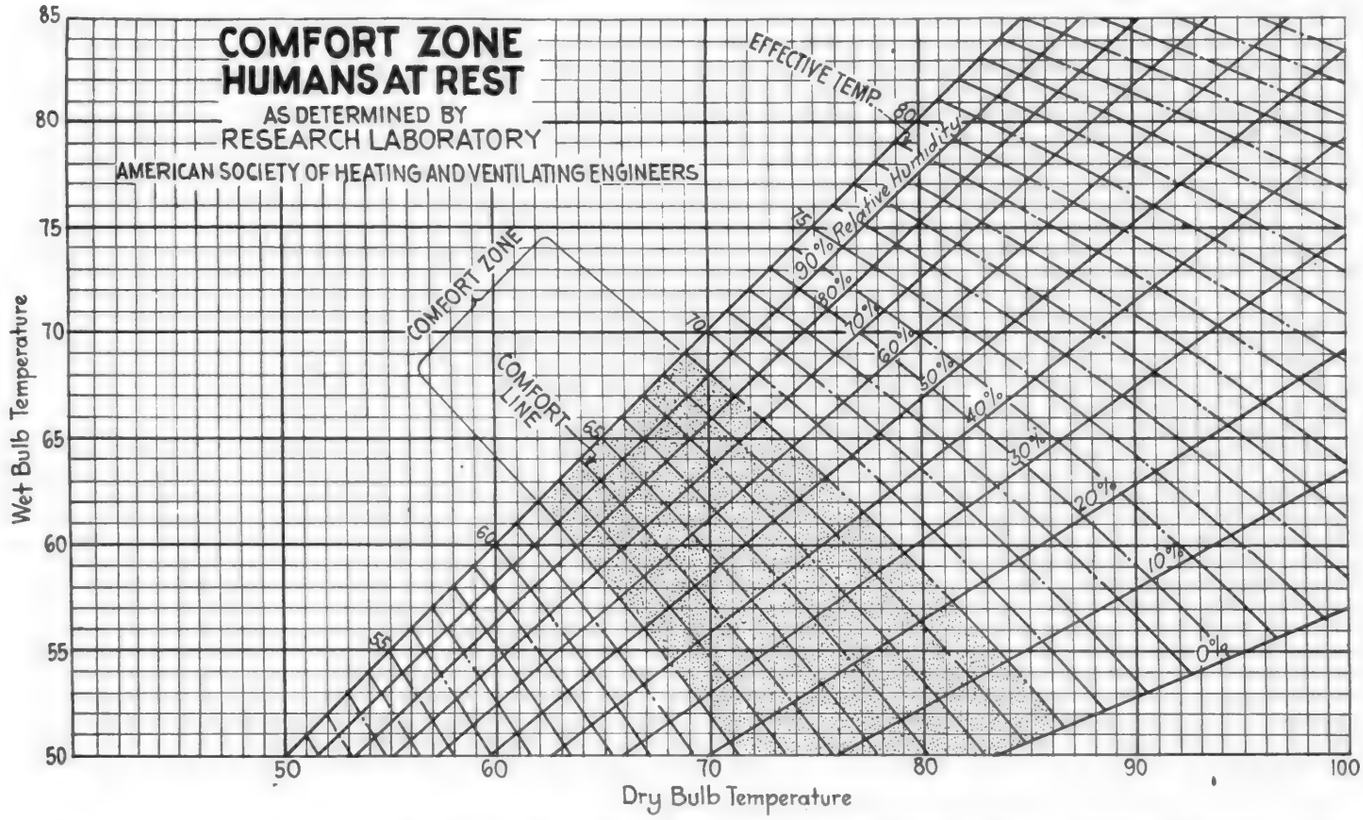


Fig. 3—Simplified Psychrometric Chart, with "Effective Temperatures," Suitable for Use Where Dew-Point and Moisture Content of the Air Are Not Desired

This could not be experimentally verified for the reason that it was impossible for the investigators to endure the conditions long enough to determine lines above 115° saturated.

Below 67°, the angle between the equal-comfort lines and the dry-bulb lines diminishes rapidly, approaching zero at 32°. For all points on the 32° equal-comfort line, comfort is independent of wet-bulb temperature or relative humidity.

Below 32° there is a marked reversal in the direction of the equal-comfort lines, and under these conditions the higher the wet-bulb temperature or relative humidity the greater the cooling effect of the air. This fact, while not generally accepted, receives ample verification from the experience of people who have dwelt in cold climates.

The equal-comfort lines as drawn in the chart are straight. While within the limits of experimental error this is true, there may be possibly a slight curvature, which will, however, in no case affect more than 0.5° any point on any line within the region of the chart investigated.

A more simple psychrometric chart is given in Fig. 3, where the relation between dry-bulb, wet-bulb, and effective temperatures, is more clearly shown. The chart can be readily used in cases where dew point and moisture content of the air are not desired.

It has already been shown that the wet-bulb temperature does not alone indicate a person's feeling of warmth. While neither the dry nor wet-bulb temperature indicate the sense of warmth, the equal-comfort lines do give such an index. For example: if a person passes from any point on the equal-comfort line intersecting the saturation curve at 90° to any point on the equal-comfort line intersecting the saturation curve at 91°, an equal increase in warmth will be noticed, regardless of the path followed.

This series of equal-comfort lines can therefore be thought of as a temperature scale, which unlike the wet-bulb and dry-bulb scale, determines accurately a person's feeling of warmth. The best way to fix the numerical value of the new scale is to adopt the value common to all scales at their intersection with the saturation curve.

As already stated and will be further verified, this temperature-scale accurately indicate a person's feeling of warmth, and determines the physiological reactions of the body—in other words, it entirely determines the effects produced upon the body. It may therefore be called a "Scale of Effective Temperature." The writers are cognizant of the fact that this so-called effective temperature-scale neither indicates the temperature of the air nor that of any other object associated with the air, and that the use of this term may not be in entire accordance with the accepted scientific terminology; but they are thoroughly convinced that such a temperature-scale will be of sufficient value in the art of heating and ventilation to justify this departure.

HOW PHYSIOLOGICAL REACTIONS FOLLOW NEW TEMPERATURE SCALE

Incidentally, in parallel with this work, the Bureau of Mines, in cooperation with the Research Laboratory of the American Society of Heating and Ventilating Engineers and the U. S. Public Health Service, is investigating the physiological reactions of men to various air conditions, and a report* of this work is available. After determining the effective temperature scale by sense reactions alone, it is gratifying to find that the physiological reactions as determined in the investigation referred to also follow the new temperature-scale as closely as could be expected, considering the difficulties involved in determining physiological reactions.

In order to emphasize further the importance of effective temperature over the wet-bulb temperature in determining comfort, some experimental facts are graphically shown on the psychrometric chart, Fig. 4. Air conditions for the test are shown by points on the chart. The number of the test, increase in pulse-rate, rise in body temperature, and loss in weight per hour are given numerically in rectangles around the points. Three series of tests are given which are very close to the three comfort lines drawn. Tests No. 56, 72, and 80, falling near the 106° effective temperature line, produce increases in pulse-rate of 105, 128, and 124, respectively. Temperature rises and loss in weights per hour show a similar uniformity.

While these physiological reactions vary considerably among themselves, they are of a different order of magnitude from those found in the next lower series—that is, near the 101° effective temperature line. Near this line are four tests, No. 53, 76, 78 and 79, which give similar physiological reactions. Again, on the 95° effective temperature line we have four tests which give similar physiological reactions, but quite different from those of the other two series.

Test No. 53 is 1° wet-bulb higher than test No. 80, but 5° effective temperature lower. It is found that test No. 80 gives an increase in pulse-rate of 124 and temperature rise of 4.6°, while test No. 53 gives an increase in pulse-rate of 56.3 and temperature rise of 2.53°, which shows clearly that the physiological reactions in this region of the chart depend upon effective temperature and not on wet-bulb temperature. When the effective temperatures are lower, the physiological reactions are less marked, despite the fact that the wet-bulb temperatures are higher.

Tests No. 44 and 79 similarly show the fact that the physiological reactions depend upon effective temperature and not upon wet-bulb temperature. This is again brought out by tests No. 81, 74, 45, and 83. The lower the effective temperature the less marked the physiological reactions, regardless of the wet-bulb temperature.

APPLICATION OF RESULTS

The air-conditioning engineer is interested in knowing just what effect various changes in wet-bulb and dry-bulb temperature will have upon the effective temperature or sense of warmth which a person will experience, and to improve conditions he can follow three distinct routes on the chart in producing a more desirable condition or any combination of the three as follows:

1. Keep the dry-bulb constant, and vary the wet-bulb and dew point.
2. Keep the wet-bulb constant, and vary the dry-bulb and dew point.
3. Keep the dew-point constant and vary the dry and wet-bulb.
4. Employ any combination of above three.

For example: let us assume a condition of 102° dry-bulb and 87° wet-bulb or 57% relative humidity. (This is the condition found at the bottom of the St. John del Rey mine in Brazil in March, 1920). From the chart

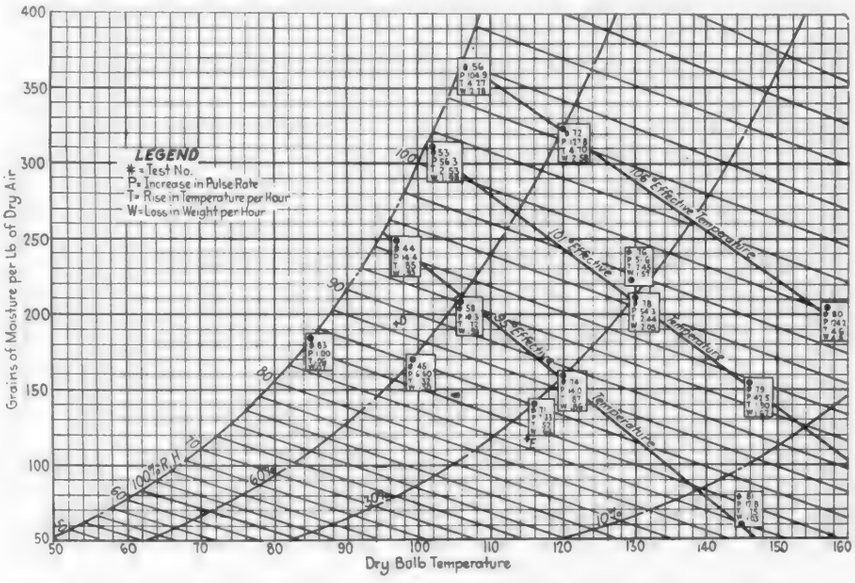


Fig. 4—Psychrometric Chart Showing Relation Between Physiological Reactions and Effective Temperature, Wet-Bulb Temperature and Dry-Bulb Temperature, Respectively

* Some physiological reactions to high temperatures and humidities, by W. J. McConnell and F. C. Houghten, Jour. Am. Soc. Heat. and Vent. Eng., March 1923, pp. 131-163.

extended we find that this gives an effective temperature of 90.7°. This condition will give a person the same sense of warmth, the same discomfort, and the same physiologcial reactions or, in other words, will produce the same effect on the body as 90.7° dry-bulb and 100% relative humidity. A person cannot work indefinitely in this condition. Experiments show that a person at rest with still air in this condition will show a slight increase in pulse rate and rise in body temperature for this condition at the end of one hour.

The effect of saturation temperatures on the comfort and physiological reactions of men at rest in still air are well known. The effect of the same conditions on men working at various rates will also be determined in the near future. With these data and the use of the chart, as in the above example, it is a simple matter to determine the equivalent saturation temperature for any given condition of temperature and humidity in still air.

The above condition is unendurable for continuous work, therefore, the engineer wishes to know how to improve it, what relief can be expected from any change contemplated, and the cost in power to obtain such results, so let us consider each of the four methods of improvements given above.

1. If the dry-bulb temperature is kept constant and the moisture in the air is reduced, the relative humidity, wet-bulb temperature, dew point, and also the effective temperature of the air will be decreased. The given condition has a dew point of 83°, found by following the horizontal line through this condition to the left to its intersection with the 100% relative humidity line. By following the same horizontal line to the extreme left of the chart it is found that 171 grains of moisture are contained in each pound of dry air. If 43 grains of water are extracted from each pound of dry air, the dry-bulb temperature will remain the same, the dew point will be reduced to 74.6° and the wet-bulb to 81.2°. The effective temperature, which is a true measure of the improvement, will be reduced from 90.7° to 87°; 87° effective temperature is the equivalent of 87° dry-bulb with 100% relative humidity, which condition a man can endure indefinitely at rest in still air. While it is possible to improve conditions by this means it is not very practical, for the reason that no inexpensive means is available for extracting moisture from the air.

2. By keeping the wet-bulb temperature constant, decreasing the dry-bulb and increasing the dew point, we may move along the 87° wet-bulb line to 87° saturation, thereby decreasing the effective temperature from 90.7° to 87°. Since effective temperature is a true index of comfort and physiological reactions, the same improvement will be experienced by this change as by decreasing the moisture content of the air from 171 to 128 grains, and thereby reducing the effective temperature to 87°. While the first means of improvement was accomplished by reducing the moisture content of the air, the second method is obtained by increasing the moisture content from 171 grains to 196 grains. This means of relief is simple to attain where water is available and is also inexpensive. All that is necessary is to evaporate 25 grains of water per pound of dry air. If the temperature of the water is the same as the wet-bulb temperature of the air, the exact result indicated above will be obtained; if the water is at a lower temperature than the air, a greater improvement will result.

3. If the dew point or moisture content of the air is kept constant, and the air is cooled, the change will be indicated by a point moving from the given condition on the chart horizontally to the left. In order to obtain the same improvement as indicated as above—namely, from 90.7° to 87° effective temperature—the dry-bulb temperature must be lowered from 102° to 92.5°. The wet-bulb temperature will be reduced from 87° to 85°. While this change is easy to attain, it is usually not very practical as regards economy because as a rule resort must be had to mechanical refrigeration, which is expensive.

4. There are two combinations of the first three methods of improvement which are worthy of consideration. First, the air can be cooled at the same time that its moisture content is decreased. This is of little practical value, because both drying and cooling are usually expensive processes. Second, the air can be cooled at the same time that moisture is being added. A path on the chart will then be followed upward, and to the left between the 87° wet-bulb line and the dew point line (horizontal line) passing through the given condition. This path cuts effective-temperature lines at a greater rate than the same change along the wet-bulb line, but not so fast as the same change along the dew-point line. This path will be followed by evaporating water at the same temperature as the air and cooling at the same time. The greater the cooling effect, the more nearly will the path parallel the dew-point line, and more of the effective-temperature lines will be cut for a given change. Hence, the greater the improvement of the condition. This is the path followed when water at a lower temperature than the air is evaporated. Where cold water is available this is usually the most desirable change. It is usually impractical, however, to make such a change where mechanical refrigeration must be employed for the additional cooling.

In all instances mentioned above, the improvement depends solely upon the number of the effective-temperature lines crossed.

CONCLUSIONS

1. Comfort, as determined by both sense and physiological reactions, depends solely upon effective-temperature. At 32°, the effective-temperature line coincides with the dry-bulb temperature line; hence, in this particular case dry-bulb temperature is the only factor in determining comfort.

2. In the comfort zone, comfort depends equally upon wet and dry-bulb temperatures.

3. At about 132° the effective temperature coincides with the wet-bulb temperature, and for this case the wet-bulb temperature is the only factor.

4. Below 32° the effect of humidity is reversed—that is, the lower the humidity the greater the feeling of warmth.

O. W. Armspach and W. H. Carrier assisted in this work with many constructive suggestions and criticisms. R. L. Lincoln and E. C. Emanual served as observers, and willingly endured the undesirable heat conditions associated with the tests.

The Trend in the Unit Heater Field

With Special Reference to the Use of Copper and Brass Radiators as a Means of Reducing Size and Weight and Increasing Efficiency

By Arthur H. Greene

ALL problems concerned with the heating of industrial plants are not, as might be supposed, connected with the fuel question. To mention but two or three others commonly occurring is that of cost of the heating installation, space requirements, and the efficiency of the unit.

Systems of direct radiation have been, of course, long in favor for both industrial and domestic heating purposes. The growth of ever larger factory buildings, however, such as foundries, machine shops, etc., combining large open spaces with high ceilings, has not only made direct systems of radiation extremely costly, but in some instances inefficient from the standpoint of fuel consumption and temperature effect. It has been in the attempt to compensate for these factors that various systems of indirect radiation have been introduced by heating and ventilating engineers.

CONDITIONS WHICH UNIT HEATERS HAVE TO MEET

The most recent system of this type introduced is that

Fig. 1—Typical Installation of Buffalo Unit Heater, Ceiling Type

known as the unit heater. This consists in the main of a heating surface, a fan and motor for creating circulation, and a single steam and return pipe system. Before attempting to list the advantages claimed by manufacturers for the unit heater system, it is advisable to first point out some of the difficulties met with in attaining an efficient unit, and to call to mind some principles governing successful installation and operation. In this latter connection it must be borne in mind that the requirements met here are not only severe but vary over wide limits. The demands made of the unit heater are very irregular because of two conditions: the amount of air to be heated may be any quantity within the limits of the fan capacity, and the temperature range of the air entering the heater may vary considerably within short periods.

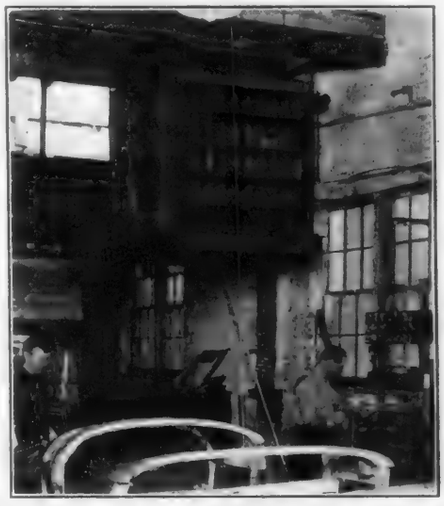


Fig. 2—Ceiling Type of Buffalo Forge Unit Heater, Showing Small Space Requirements

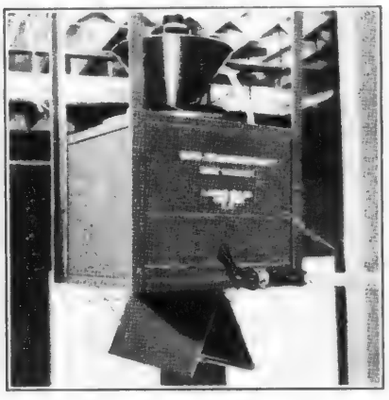
As we are now considering the heating of factory buildings, for which, under normal conditions, natural leakage supplies ample fresh air for ventilation, the amount of air to be passed through the unit heaters should be such as to give good diffusion in order to provide uniform temperature. In addition, this air, when heated through a range of about 40° should supply the required amount of heat. In a building in which fumes or dust are present, outside air should be introduced, and a more frequent air change is required than one in which the air is clean. From two to four changes per hour have been found to give excellent results. This, of course, adds to the steam requirements.

Having the dimensions of the building, and the figures on air requirements, it is a simple matter to determine the amount of air to be handled. The heat to be supplied to the air will be that necessary to make up for the total estimated heat losses. The transmission heat losses can be figured, but the loss due to infiltration can only be decided for each case and is largely a matter of practice. It is customary to provide for at least one change of air every hour.

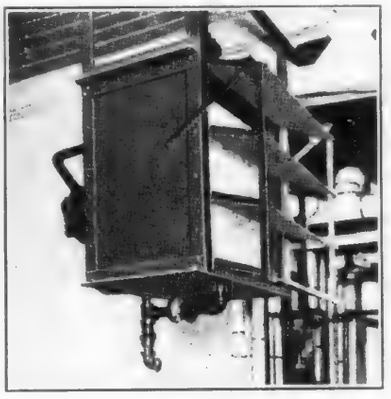
Various types of heater units have been offered, all of which embody much the same principle of combining small space requirements, small weight and high radiating surface.

TYPES OF RADIATION USED IN UNIT HEATERS

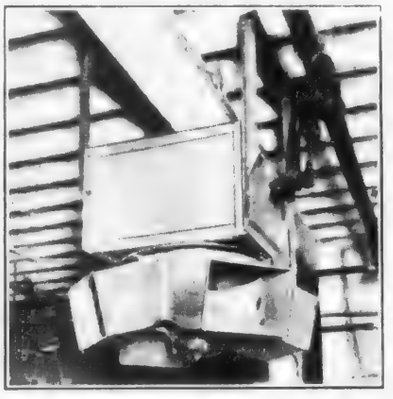
For purposes of this discussion, the type of radiation most commonly made use of can be divided into three main divisions. These consist of wrought-iron pipe coils, cast-iron heater sections, or copper tubing with a thin, narrow, helical extended surface. To consider these briefly in turn, the wrought-iron pipe coil radiation surface is simple in construction and design, but highly efficient. It is made up of 1-in. full-weight steel pipe, screwed into cast-iron bases, each of which usually carries four rows of pipe. The pipes are staggered in order to baffle the air as it passes through, and are usually connected in pairs by bends.



High-Ceiling Type



Horizontal Type



Low-Ceiling Type

Fig. 3—Wing Unit Heaters, Ceiling Type, Equipped with Cartridge Copper Radiators

The cast-iron heater sections, built on practically the same principle as the pipe-coil radiation, consist of stacks of heaters having projections, so arranged that the air here is baffled as it passes through. The construction, in addition to breaking up the air currents, makes for rapid steam circulation, both these features being necessary to insure full heating efficiency in any heater unit. The last division of transmitting surface used, which is the newest as well, is that of copper or brass tubes. Because of its recent introduction and unique construction features, this division of radiation is worthy of some note.

One type of copper or brass radiation, known as Aerofin and now being used extensively by the Buffalo Forge Company* in its unit heaters, is made of straight seamless copper or brass tubing about which is wound a thin narrow helical extended surface, also of copper or brass made metallically integral with the tube by means of a solder bath.

The standard method of installation is with the tubes placed horizontally. It is claimed to be more efficient than the cast-iron or pipe-coil heater, because of the spacing and arrangement of the tubes effected and the large transmitting surface. Aerofin, it is stated, weighs from 9% to 16% of an equivalent surface in cast-iron radiation, and from 12% to 25% of an equivalent surface in pipe coils. The decreased weight, of course, figures especially in the reduced cost of installation. This type of radiation surface is especially adaptable to suspension from the ceiling.

The fan supplied with the average unit heater is generally of the disc type and direct-connected to a motor. This fan is set back of and some 18 in. or 2 ft. from the heater itself. A sheet-steel casing is provided with each heater. This encloses the heating surface and the fan discharges through it. In any unit heater, care should be taken to have the connection between the fan and the heater of such character that it will not restrict the flow of air or offer unnecessary resistance. This precaution is frequently overlooked, either throwing excessive pressure on the fan or curtailing the quantity of air to be handled. A series of three or four deflectors, which can be raised or lowered individually or as a unit, is provided at the front of the heater to direct the flow of air as it comes through the heater coils.

REASON FOR HIGH EFFICIENCY OF UNIT HEATERS

The mechanical principle governing the high efficiency of the unit heater lies in the fact that the condensation and heating capacity from a given amount of properly-designed radiation is from three to five times greater with forced circulation of air than in direct radiation. For this reason—and herein lies the factor of economy in installation—the fan system of heating requires less radiation surface than the ordinary heating system employing direct radiation.

ADAPTABILITY FOR CERTAIN CLASSES OF WORK

To consider but briefly the advantages associated with unit heater installations, one of the most important is its quickness in heating up and its even distribution of temperature. To amplify on the latter phase, it is worth noting that more heat loss is experienced by overheating of the space under the roof in one-story factories with direct radiation systems than with an indirect system. Through the principle of air circulation involved, the temperature imparted to the air is bound to be more evenly distributed than if a system of direct radiation were employed. A feature of considerable importance is the quickness with which the average unit heater can be installed. When direct radiation, or some system of indirect radiation, other than a unit heater,—such as an air duct system,—is employed, the time element of preparation is considerable. The cost element in the two cases perhaps needs no comparison here. With the unit heater, which employs no air ducts and has but one steam and one return connection, the construction problem is about as simple as could be found.

Undoubtedly the advantage most often associated with the unit heater method is its adaptability to fit in out-of-the-way corners and its small space requirements. The

* Also by the American Blower Company in its Venturafin. Another type of copper air heater, known as the Cartridge radiator, is used in the Wing unit heater, manufactured by the L. J. Wing Mfg. Co.—Editor.

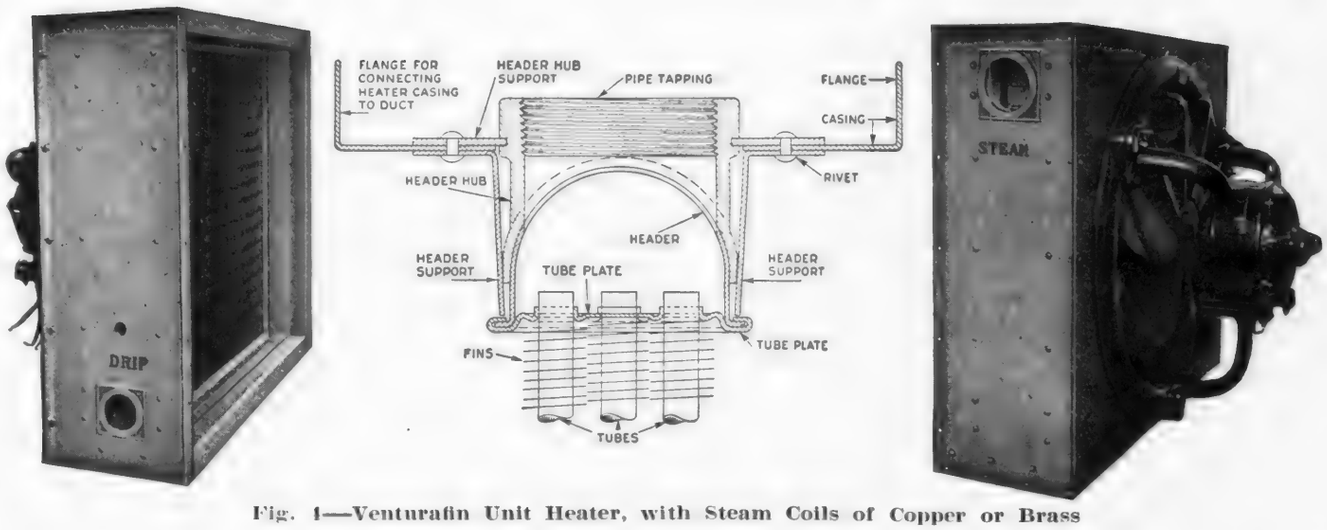


Fig. 1—Venturafin Unit Heater, with Steam Coils of Copper or Brass

Venturafin, Buffalo, as well as the Ilgair and Wing unit heaters, may be hung from the ceiling, and therefore require the utilization of no working space. This feature is especially valuable in a small machine shop or garage.

All heating systems of this kind stress the point of light weight. This factor is especially important in shipment, and in the case of an over-hanging unit, the question of weight will either save or add considerably to cost of hanger construction, depending on the heater installed.

In conclusion, it may be remarked, that the future use of unit heaters is apparently unlimited. That there will ever be much use for this heater in the home or office, however, is doubtful. Its field of application will undoubtedly continue to follow along the lines now evidenced, namely, in the factory, garage and other parts of the industrial plant.

Downward-Diffusion Air Conditioning System For a Large Theatre

How Grauman's Metropolitan Theatre, Los Angeles, Cal., is Heated, Humidified and Ventilated in Winter and Cooled in Summer

(*Additional Illustrations on Pp.* 64-65)

WHAT is considered by many to be the last word in motion picture theatre design has lately been completed in Los Angeles, Cal., by Sid Grauman, well-known as a motion picture exhibitor. The theatre, which is known as Grauman's Metropolitan, is enclosed within a 12-story office building (six stories not yet built) and was designed by Edwin Bergstrom. Both in size and elaborateness of its architectural features, this theatre easily takes rank with anything of its kind in the country. The accompanying illustrations (See Pp. 64-65) give but a faint idea of the beauty of its settings.

In keeping with the large scale on which the theatre is designed, the plans provided for a mechanical equipment which would not only heat, humidify and ventilate the auditorium in winter, but would also cool, dehumidify and ventilate it during the summer season, when so many theatres find it difficult to operate, owing to excessive temperatures and the oppressiveness of high humidities.

The Grauman Theatre contains 3600 seats, each one of which has an unobstructed view of the screen. This is made possible through the use of a great cantilever supporting the overhanging balcony which has no supporting columns within the auditorium itself.

The very nature of the building, its size as a single enclosure, its balcony overhanging the main floor, the tall opening of the proscenium, as well as the fact that it is occupied for twelve hours every day, comprised the principal problems which had to be solved in designing its heating and ventilating equipment. In addition, the heat from the myriads of lights had to be counterbalanced and removed in summer and utilized in winter.

The apparatus itself had to be placed in difficult places, so as not to interfere with the design and decoration of the building and not to encroach on valuable space. Finally, it was necessary for the entire system to be entirely noiseless and to operate, of course, without drafts.

In the system as installed, which has been given the name of the Carrier downward-diffusion system, the air is introduced overhead and diffuses downward, being exhausted through the floor by means of the same kind of mushrooms used in the updraft system.

For summer operation, the system is designed to keep all of the air in contact with the occupants at substantially the same temperature and relative humidity. The cooling air enters overhead and, as most of the lights are overhead, the heat from these is the first to be absorbed. The air then flows downward, the temperature being kept sufficiently low to absorb the heat given off by the occupants, so that the final temperature is at the desired point in the 70's, even on a 98° day. This arrangement is intended to prevent the occupants from being subjected at any time to cold air currents. It is further

provided that this temperature will not vary, no matter how much it may be necessary to vary the temperature of the entering air from the duct system to meet the changing conditions when within the theatre. This is accomplished by removing sufficient moisture in the dehumidifier which is a part of the cooling system.

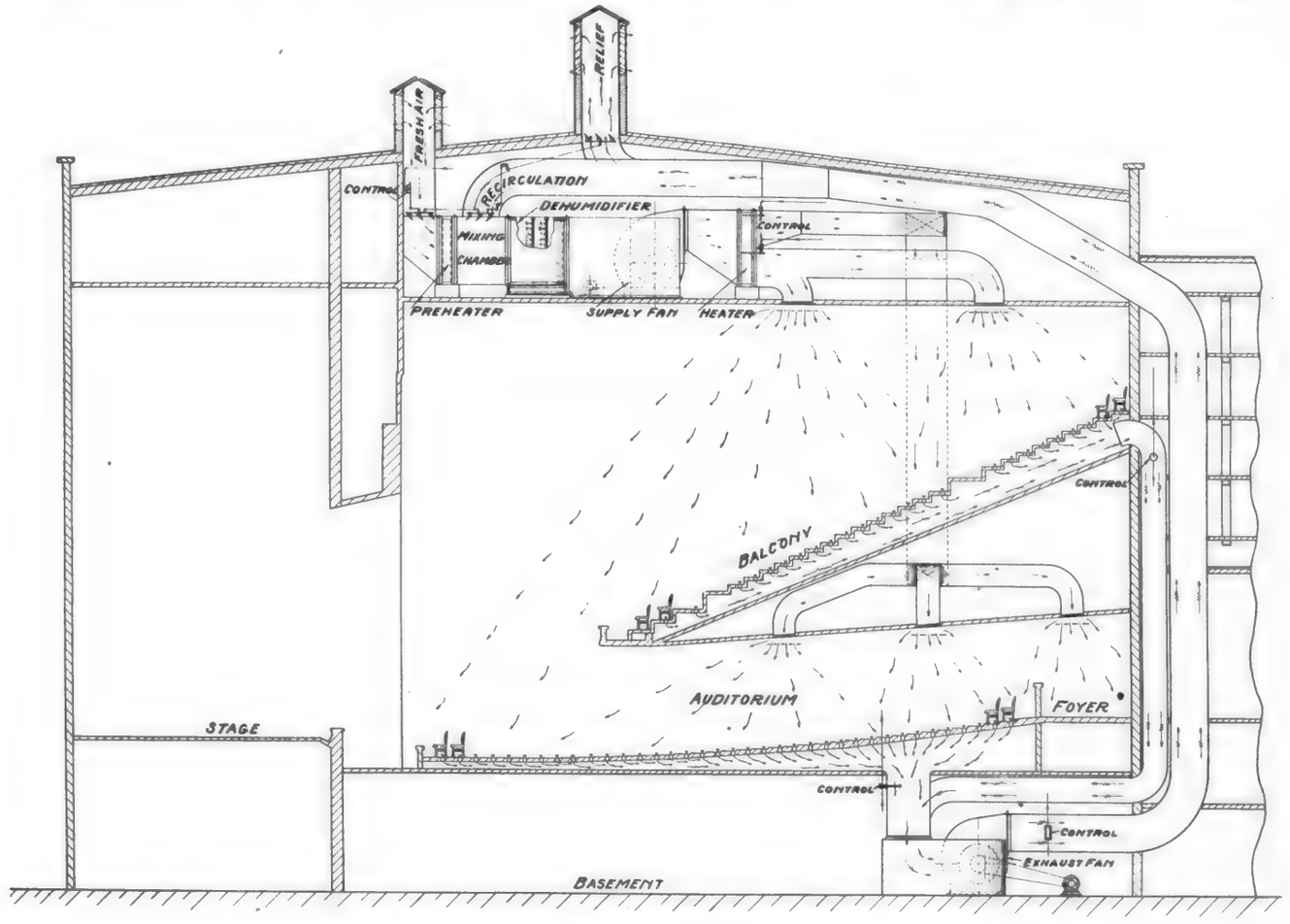
Special advantages, it is felt, have been secured by means of the down-draft system in providing comfortable air conditions in the balcony. There are no exhaust openings in the ceiling. Among other things, this has been found to act to prevent the theatre from becoming a huge stack when the doors are opened.

desired temperature. During the winter, steam is used for one hour only before the theatre is opened at 11 A. M., and for one hour only before the theatre is closed at 11 P. M., when the audience, of course, is thinning out.

SOME COST FIGURES

Some interesting figures regarding the cost of the theatre and the cost of operation show that for the theatre proper, the cost is about $26.00 per seat of the approximately $1000.00 per seat which represents the total cost of the building. The normal attendance averages about 2.38 admissions per seat per day.

Most of the air conditioning equipment was installed



SECTIONAL ELEVATION

General Arrangement of Downward-Diffusion Air Conditioning System in Grauman's Metropolitan Theatre, Los Angeles, Cal.

HEATING OF MOTION PICTURE THEATRES ESSENTIALLY A COOLING PROPOSITION

As to winter operation, the argument that heated air naturally ascends and, for that reason, should be introduced at the floor level, is met by the statement that the "heating" of a motion picture theatre is really a cooling proposition, as in summer, except that the cold air from outdoors can be washed and used, instead of operating the refrigerating machines. This practice is based upon the fact that the animal heat from the audience and the heat from the lights is sufficient to overheat the theatre, even on the coldest winter day, when the theatre is equipped to prevent "stack effect" drafts.

Thus no steam heat is used during the show hours, the temperature being automatically controlled by the admission of sufficient outdoor air to cool the theatre to the to condition the basement, containing the rooms occupied by the musicians, engineers, electricians, ushers and house staff. The cost of operation is about $500.00 per month (about one-fifth of the cost of the lighting) during the winter when no refrigeration is used. This is a little less than one-half cent per day per seat.

In summer the cost of operation is naturally considerably higher, amounting to about $73.00 per day, or 2 cents per seat per day. It should be borne in mind, however, that each seat is intended to be occupied twice each day, which would reduce the cost one-half. No account, however, is taken, in these figures, of the amortization of the equipment.

The downward-diffusion system here described was designed and installed by the Carrier Engineering Corporation, Newark, N. J., under the direction of Logan Lewis, the company's chief engineer.

Back To First Principles

Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

By T. W. Reynolds

(*Continued from the February issue*)

16. *Q. On what kind of heating systems are air valves on radiating surfaces not required?*

A. Vapor, vapor-vacuum and mechanical vacuum steam systems, also any hot water system of the down-feed type having radiator connections made with top supply and bottom return, as shown in Fig. 9.

17. *Q. Why are air valves not required on radiating surfaces of vapor or vapor-vacuum systems?*

A. In a steam heating system, the pressure of the steam entering the system will drive the air out through any points open to the atmosphere, as the pressure is above that of the atmosphere. Such points are the air valves in the ordinary steam system with gravity return of condensate, but in a vapor or vapor-vacuum system the only point of outlet is the special form of trap located near the boiler and through which the air is forced, but the water retained.

Then, again, each radiator in a vapor system is provided with a trap at its return end which will prevent the passage of steam, but allow the passage of air, along with condensation, back through the return. Consequently, the air (being heavier than the steam) falls to the bottom of the radiators and is passed through the traps into the return, thence out through the special trap mentioned.

18. *Q. Why are air valves not required on radiating surfaces of mechanical vacuum systems?*

A. In a vacuum-line system the air passes from the radiating surfaces through traps into the return, the same as in a vapor system, but from this point it is sucked back through the return by means of a vacuum pump.

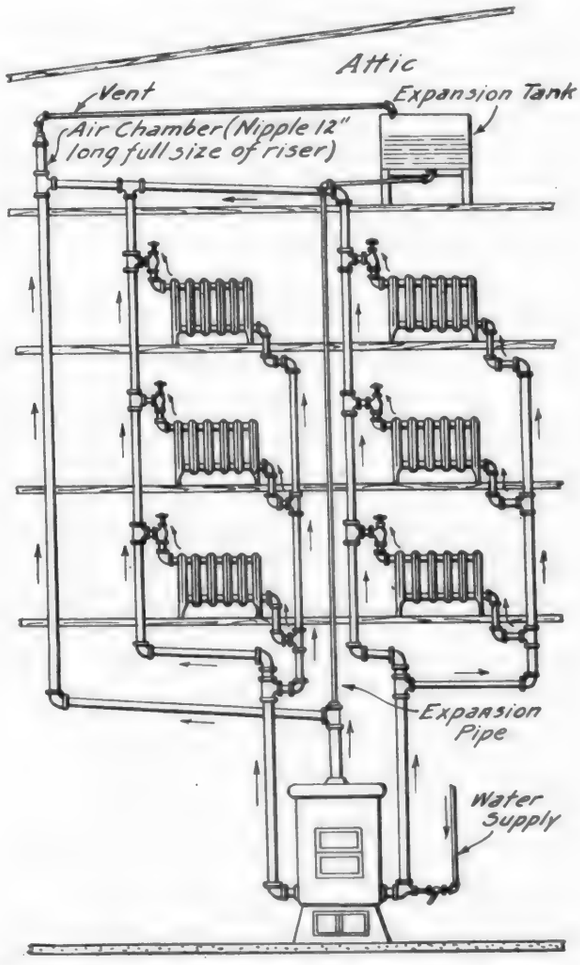


Fig. 9—Down-Feed Water Heating System Showing How Air is Relieved as System is Filled

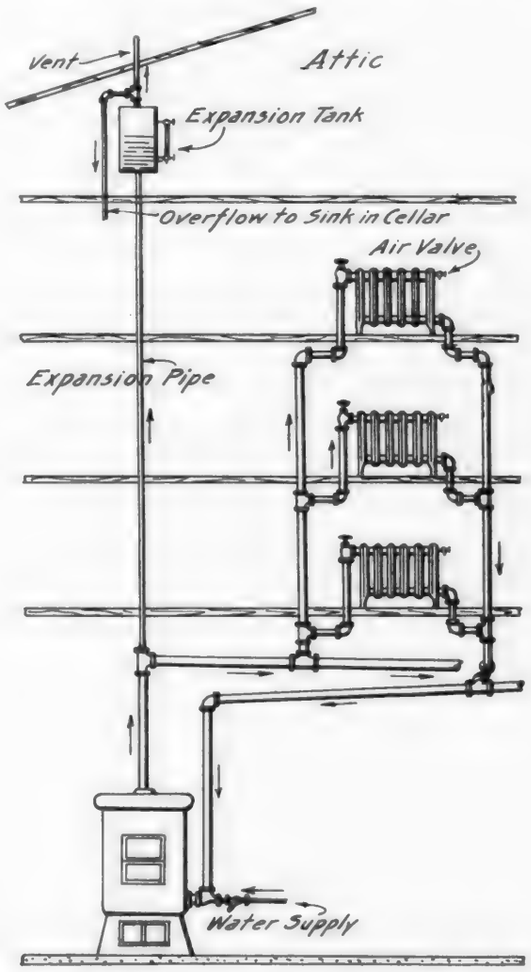


Fig. 10—Up-Feed Water Heating System with Air Valves for Relieving Air While System is Filling

Said in other words, the pump produces a partial vacuum, which is greatest at the pump, so that the pressure at the traps forces the air ahead to the lower point of pressure, which is at the pump. This pump facilitates the removal of the air and condensation by discharging these to an overhead air-separating tank where the air is vented to the atmosphere and the condensation returned by gravity to the feed-water heater. Where exhaust steam is used, the pump reduces the back pressure on the engines and other steam-driven power apparatus.

19. *Q. Why are air valves not required on radiators in down-feed (overhead) hot water system?*

A. In such a system, the supply main rises from the heater to the top of the building before distributing to the radiators below. When the system is first filled, the water enters both flow and return and the air, being lighter than the water, rises above the water, as shown by the arrows in Fig. 9, and escapes through the open expansion tank. At other times any air entering with the water is liberated at the top (high point) of the riser and is vented to the expansion tank. An air chamber should be provided at the top of the riser to allow for the collection of air at this point, otherwise the air may not be separated from the water quickly enough to prevent carrying along with the water to the radiators.

In systems of this type, the radiator connections are usually made with supply at top and return at bottom, as shown in Fig. 9. Care should be taken to make the upper connection high enough to allow all air to escape before being trapped in top of the radiator by the incoming water. If this is done, air can pass through the connections and up the risers into the overhead main and escape by way of the open expansion tank. Care should also be taken to pitch the overhead main up to the point of venting.

20. *Q. Why are air valves required on radiators in up-feed hot water systems?*

A. As will be seen from Fig. 10, though a certain amount of air can escape through the expansion line to the open tank, the air in the radiators cannot escape, as it could if the piping and radiator connections were made as shown in Fig. 9, but is pocketed, no matter whether the connections are made at top or bottom of

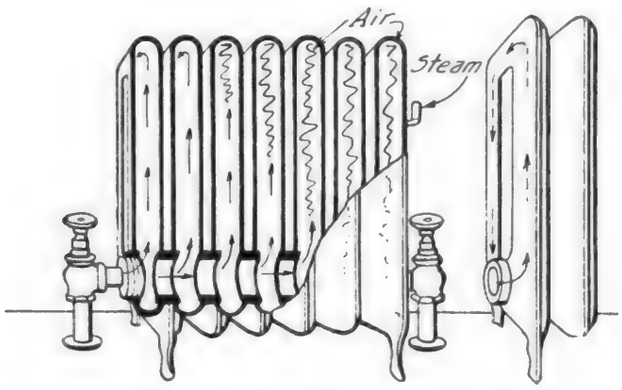


Fig. 11—Steam-Type Radiator for Steam Heating Only

radiators. Consequently, air valves are required on each radiator.

21. *Q. Why is it that water-type radiators may be used for either steam or water heating, yet steam type radiators can be used only for steam heating?*

A. If a steam radiator (Fig. 11) were used for water heating, each section would require an air valve at its top; air being lighter than the water, accumulates at the highest point. However, by connecting each loop or section at its top with nipples, so as to provide a continuous horizontal passage, only one air valve is necessary, and so we have water radiators with top and bottom through passages (Fig. 12) and steam radiators with bottom passages only (Fig. 11).

22. *Q. Why do we have two types of cast-iron column radiation (steam and water) when the water-type of radiator can be used for either steam or water heating?*

A. To manufacture one type of radiation would be convenient for the manufacturer and simplify his problems. On the other hand, the water type of radiator costs slightly more, due to its greater weight and labor for machining the extra nipples required at the top. Then again there are certain conditions of steam heating for which water radiators are not suited.

Water-type radiation for steam heating is not recommended, except for two-pipe vapor or vacuum, with top and bottom connections at opposite ends, as in Fig. 12.

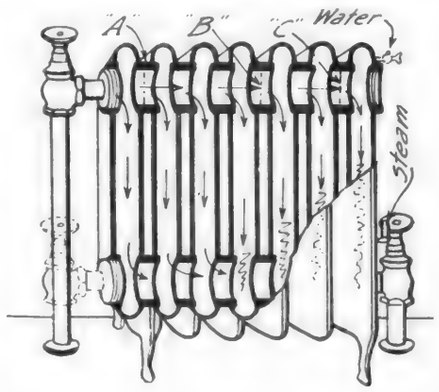


Fig. 12—Water-Type Radiator for Steam or Water Heating

Under other conditions, steam may take any of the many paths. For example, if the bottom inlet shown dotted is used, the steam (as its motion is arrested by the air cushion within the radiator) being lighter than air, will rise in the first sections and may reach and close the air valve before the other sections are fully vented. However, in time the air will be expelled.

For vapor or vacuum heating, no air valves are required, nevertheless, air conditions must be considered as before. Connections should preferably be made at top and bottom, opposite ends, not only because the modulating supply valve should be placed hand-high, but, also, because, with other connections, steam might close the thermostatic valve prematurely. It should be remembered that in vapor or vacuum heating there is but little in the way of an air cushion within the radiator to check the entrance velocity of the steam. This is because the air is more quickly relieved through the return pipes and the large quick-venting valve at the boiler end of the return than in the ordinary low-pressure steam system, where the only air relief is through the pin holes of the usual small radiator air valves. Bottom connections should not be used for vapor or vacuum heating, nor should top and bottom connections on the same end be used, as the steam may short-circuit from top to bottom. However, the connections are sometimes made from the same end, if the radiator is no longer than its height.

23. *Q. At what point on a radiator of the cast-iron column type should the air valve be placed?*

A. For steam heating it should always be placed at the end of the radiator opposite the steam inlet, and in theory at the bottom of the radiator, as the air is heavier than the steam, it tends to settle to the bottom, unless prevented by other factors that may enter into the prob-

lem. However, the manufacturers of radiators have found from tests and experience that the best position for the air valve on steam radiators is two-thirds of the way up, and, on water radiators, when used for steam heating, one-third up from the bottom. Accordingly, they have provided air valve tappings at these points, as well as an additional air valve tapping on water radiators for use in water heating. This last tapping is placed at the top of the radiator on the end opposite the inlet.

Water-type radiation must be used for steam heating when the number of columns is four or over, as four-column radiation is not obtainable in the steam type.

24. *Q. Why is the position of the air valve for steam heating different on steam-type radiators from that on water-type radiators, even though both types of radiators in this case are being used for steam heating?*

A. The reason for this is the difference of steam circulation which takes place within the two types of radiators, due to their difference in construction. This is clearly shown in Figs. 11-12. For example, Fig. 11 shows the steam-type radiator with nipples connecting the section at bottom only, thus providing a through and direct passage to the return end. When steam is turned on it enters the radiator, compressing the air and forcing it ahead. Rising up one column of the first section, the steam, as shown in end elevation, passes down the other column of the same section and the air falls before the advancing steam, due to the greater weight of the air and pressure of the steam. Steam and air then pass up and down each section in order, as shown by the arrows, until the last section is finally reached, freed of air, and filled with steam.

Theoretically, the air valves should be placed near the low point, but the higher position shown in Fig. 11 accords with experience and lessens the liability of flooding, particularly with one-pipe connections, where the condensation may all pile up at this end when the radiator is first heating.

For water-type radiation, the connections are more usually made as shown in Fig. 12. Laws of nature are followed. Steam—the lighter element—is introduced at the top and the air and condensation falling, due to their greater weight and pressure of the steam, settle to the bottom, so that in this case the air valve is located only one-third up. There is also less danger of flooding the end section, as the connections are usually two-pipe and the top and bottom passages allow the steam to equalize at top and bottom of each loop. Furthermore, if the air valve was placed nearer the top it would be more liable to premature closing, due to the number of paths which the steam may take in a radiator of this type. To offset this condition, one of the top nipples is sometimes plugged, either the one just before the second or end sections, or else the one at the middle section as at "A," "B," or "C," though the last point is preferable.

(*To be continued*)

Natural Gas Heater Tests for Carbon Monoxide

During the past two years the Bureau of Mines has conducted a study of natural-gas heaters to determine (1) what types of heaters liberate carbon monoxide; (2) why carbon monoxide is liberated; and (3) how, by change of design or construction, the liberation of this gas can be largely eliminated. The study was conducted by G. W. Jones, associate chemist, and W. P. Yant, assistant gas chemist, of the Pittsburgh Experiment Station of the Bureau of Mines. In connection with the study, the Bureau investigated causes in the Pittsburgh district where fatalities have resulted from carbon monoxide given off by natural-gas heaters.

It was found that the great majority of the heaters are of the radiant type. In every case listed, none of the heaters was connected to a flue, the combustion products being liberated directly into the room. The Bureau has not found any case where fatalities have resulted from natural-gas heaters in which the products of combustion could be carried off through the chimney to the outside. Along with the fact that none of the heaters was connected to a flue, it was also found that the rooms were, with one exception, tightly closed, and in many cases the cracks sealed up with weather stripping.

The main glaring cause of liberation of carbon monoxide, it was found, is due to excessive gas flows arising from too large gas orifices. Adjustible orifices, it is stated, are dangerous unless limited to such a size that excessive gas flows cannot be obtained, even at the maximum gas pressure available in the locality where used.

Second in importance is that of primary air supply. Natural gas in the Pittsburgh district requires about ten volumes of air to one of gas to insure complete combustion. In some of the radiant heaters tested, the primary air only amounted to from about 4 to 7.5 volumes. In such cases there is not enough secondary air obtained in the radiant heater to give complete combustion. The figures in detail are given in a paper on the subject (Serial No. 2572, Reports of Investigation) published by the Bureau of Mines.

Electric Heating in Seattle

Heating by electricity is the most convenient of all methods and is perfectly feasible, although not as economical as the older methods. Experiments continuing over a period of years since 1911 by the Lighting Department show that current at ½c is approximately equal to coal at $8.00 per ton. While heat is sure to be used as an auxiliary and in special cases where expense is not the primary consideration, the fact that so much energy is required—it would take approximately 1,000,000 kw. to heat the City of Seattle adequately in cold weather—will prevent its use in any more than an auxiliary capacity unless the rising price of coal leads to more rapid financing of hydro-electric plants and the extension of this method of heating. Even under present conditions there will be an enormous use of heating devices in Seattle.—From the 1922 annual report, just issued, of the Department of Lighting of Seattle, Wash., J. D. Ross, Superintendent.

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MANY comments have been heard lately, especially among those connected with the heating and ventilating industry, on the need of simplifying the terms and methods of expression used in reports of research or other work, compiled for the benefit of the profession. This sentiment, we are sure, is finding a responsive echo in engineering circles generally. While admitting the necessity for terms which will have the required accuracy of definition, the fact remains that if new and useful engineering data are to come into general use, they will either have to be presented in language readily understood, or they will be translated into the vernacular by those who use the data.

We can readily understand the viewpoint of those who feel that scientific and engineering terms are not to be discarded at will in favor of something which will be more intelligible to the self-made engineer. As has been well said, if the self-made engineer is worthy of the name, it is decidedly up to him to familiarize himself with the nomenclature of the science of engineering. We do not think, however, that this is the crux of the situation. The trouble is not so much with the terms themselves as it is with the scientific approach to a given subject which leads to an involved presentation which is orderly enough, but which is characterized very often by a nicety as to details and completeness through which the reader has literally to plough to get at the meat of the matter.

In defense of the scientific method of presentation, it must be borne in mind, of course, that there are two requirements to be met. One is the handling of the subject in a way that will render it as useful and complete for future reference as for present use. It must be recognized that the more important of these reports go into the archives of engineering and scientific libraries and, therefore, must be able to stand the usual tests of scientific criticism. The other requirement is the necessity of making the data immediately available to the busy men who are vitally interested only in the results themselves, provided they come from reliable sources, and who, in that case, will take for granted the accuracy of the data. So, for want of better terms, there is the encyclopedia phase to be considered and the data sheet phase. The present criticisms, as we understand them, are directed largely at the tendency to emphasize the encyclopedia phase and to neglect the other phase.

In the last analysis, no research work will amount to very much unless its results can be used, not only by scientists, but by the industry most directly concerned. In the recent presentation of much of the valuable material connected with engineering research, both here and abroad, the essential data, in many cases, have been cloaked in such a mass of scientific verbiage as to come pretty near to being buried, as far as the average reader is concerned. We believe it will shortly become necessary—it certainly is highly desirable—to present new research and similiar data from two angles, one presentation to be of an encyclopedic character and the other to be along "popular" lines, with the essential facts summarized and whipped into shape for practical and convenient use.

CONSIDERABLE space is being devoted in this issue to the new fuel-oil regulations for New York City which have recently been adopted by the New York City Board of Standards and Appeals. Perhaps the most important provision in the new rules, as far as the use of fuel-oil for house heating is concerned, is the prohibition of the use of tanks of more than 60 gal. capacity in any building. In view of the interest in the subject of fuel-oil heating, which is literally sweeping the country, more than usual interest will be felt in the measures taken in New York to meet the situation. For the benefit of our readers who desire to become more fully posted on fuel-oil for house-heating purposes, attention is called to our recent reprint, under the title of "House-Heating with Fuel-Oil" containing a number of the more important articles and tables on the subject which have appeared recently in THE HEATING AND VENTILATING MAGAZINE.

WITH this issue we begin the publication of data sheets giving essential information on concealed radiators. The growing use of concealed radiation is one of the signs of the times. It is part and parcel of the demand for more luxurious living comforts in which the means for providing warmth are carefully kept out of sight. The data sheets now in preparation will cover all of the commonly-used sizes and types of heating surfaces, and will include radiators with front and top registers, full front registers, window-type enclosures, enclosed coils with different types of enclosures, radiators with shields, and recessed radiators with different heights and depths of recesses. In addition, a separate series of data sheets is in preparation containing similar data for radiators of the water type.

A Symposium on Hot Water Systems for Heating Industrial Plants

An investigation undertaken by B. W. Randolph, M. E., of New York, among prominent engineers and architects throughout the country as to their opinion of the merits of water heating for warming industrial plants, has brought forth some remarkable comments.

In asking for expressions of opinion from his correspondents, Mr. Randolph told them of his own conclusions that water heating systems were more desirable than others and asked if their experience bore him out that they were more advantageous from the standpoint of mildness and healthfulness, elasticity of operation, facility of installation, economy of fuel and economy of labor.

Replies were received from H. R. Neff, of the George S. Rider Co., Cleveland, O.; J. A. Almirall, New York; Alphonse A. Adler, New York; Fermor S. Cannon, architect, of Indianapolis, Ind.; A. T. Hawk, engineer of buildings, Chicago, Rock Island & Pacific Railway, Chicago; George D. Mason, architect, Detroit, Mich.; William C. Clark, of the Becker Seidel Co., Cleveland, O.; R. Carter Beverley, of the R. C. Beverley Heating Co., Richmond, Va.; A. L. Sanford, mechanical engineer for the Board of Education, Minneapolis, Minn.; H. A. Erickson, of the Fitzpatrick & Hoepfner Co., Columbus, O.; H. I. Schenck, of Schenck & Williams, Dayton, O.; Ernest V. Lippe, mechanical engineer, Chicago, Ill.; A. W. Moulder, the Grinnell Co., Warren, O.; E. V. Hill, of the E. Vernon Hill Co., Chicago, Ill.; Herbert Foltz, architect, of Indianapolis, Ind.; John Gormly, Norristown, Pa.; Arthur Peabody, of the Department of Engineering, State of Wisconsin, Madison, Wis.; W. B. Graves, of the W. B. Graves Heating Co., Chicago, Ill.; D. H. Cuyler, of Haines, Jones & Cadbury, Charlotte, N. C.; C. H. Blackall, of Blackall, Clapp and Whittemore, architects, Boston; David M. Nesbit, consulting engineer, Leicester, England; Holyoke Davis, of Holyoke, Jemne & Davis, architects, St. Paul, Minn.; Henry H. Kendall, of Kendall, Taylor & Co., Boston; Leland Stanford Kemnitz, of Detroit; James Burke, president of the Burke Electric Co., Erie, Pa.; J. Monroe Hewlett, of Lord & Hewlett, architects, New York; Walter E. Gillham, consulting engineer, Kansas City, Mo.; Warren J. Davis, of the J. I. Case Threshing Machine Co., Racine, Wis.; F. F. Van Tuyl, consulting engineer, Detroit; Webster Cigar Co., Detroit; F. D. Mensing, of Mensing & Co., Philadelphia, Pa.; Albert Kahn, of Albert Kahn and Associates, architects and engineers, Detroit; Donn Barber, architect, New York; and Professor Howell M. Gano, of the University of Idaho, Moscow, Idaho.

Taking the replies in order, H. R. Neff endorsed the use of water heating systems in industrial plants. J. A. Almirall, naturally, was enthusiastic over this practice, mentioning the fact that his firm was a pioneer in installing and developing water heating for industrial institutions. He did say, however, that the matter is one for detailed consideration which might affect the type of system which should be installed in any industrial plant, and which can only be determined by a careful study of each situation, both as regards the size of the plant, the purpose for which it is to be used, the type of power plant, and other engineering details.

Alphonse A. Adler had some comments to make regarding the increased cost of radiation in the case of gravity water heating systems and Mr. Randolph makes the comment that such systems would practically never be used in industrial plants such as those under consideration.

Fermor S. Cannon states his willingness to agree that "when the cost of radiation and pipes come down, I will be very much more inclined to specify hot water heating systems than any other type, because I quite agree that the temperatures are more easily maintained and the economy of operation has been proven many times." Mr. Randolph's comment on this is that with a water heating system, the radiating surfaces can be installed in much larger units and, consequently, a smaller number of them, plus the fact that the pipe sizes in a properly-designed system are smaller than with steam and that the number of accessories is not great, are offsetting factors against the additional amount of radiating surface.

A. T. Hawk expresses himself as favorable to the use of hot-water systems, as does A. O. Blackman. Mr. Blackman, however, points out the fact that the hot water system of heating requires a somewhat larger initial investment than the low-pressure steam heating system, but that the economy of operation, and fuel saving more than offsets the higher first cost of heating and pumping apparatus. Mr. Randolph's comment on this is that the reported excess cost of a hot water system has been exaggerated. He reports finding several cases, for instance, where the cost of the hot water installation was actually less than steam. In a large plant, he figures, the additional cost is very rarely more than 15%.

George D. Mason endorses water heating and cites the fact that this method was used in the Lincoln Motor Companys' plant, now owned by Henry Ford, in which was installed over 60,000 sq. ft. of radiation.

William C. Clark writes that the condition of the plant to be heated determines the kind of system to be installed and mentions that his firm is changing the Ford Motor Car Company's plant in Detroit from hot water to steam. "This particular Ford plant," comments Mr. Randolph, "is being changed from hot water to steam on account of a drying proposition and not because of any difficulty with the hot water system." He cites the Ford Motor Company as among the most enthusiastic advocates of water heating.

R. Carter Beverley strikes a discordant note, stating that "in our experience vapor heating is equally as advantageous as hot water in all five points mentioned, and with vapor heat there is no danger of freezing when the apparatus is not in use. For small plants, he states, he uses vapor heat and, for large plants, steam with vacuum return, using either steam or electric-driven pump, as may be found best under the special conditions existing. Commenting on this expression, Mr. Randolph states: "It is my understanding that vapor heating systems are usually installed only in small plants, due to the fact that they are operated at such a low pressure. Mr. Beverley evidently had a small plant in mind also, as is evident from his comment regarding shut-downs over the holidays, etc., as most large industrial plants, for various reasons, could not do anything of that kind."

A. L. Sandford writes that water heating plants "are probably superior to any other type of heating system."

H. A. Erickson expresses the opinion that large institutions, such as hospitals, etc., can be operated a great deal more economically and with greater elasticity of operation by the hot water method than by steam. He states that he is engaged at present in redesigning a large institution in Ohio which is partly gravity hot water and the rest steam, in which he anticipates converting the whole plant to a central station on a hot water basis. In his comment, Mr. Randolph points out that one of the best examples of central station water heating is in Bridgeport, Conn., where a group of houses for A. & E. Henkels, Inc., is heated by a forced circulation water heating system.

H. I. Schenck makes out a case for a fan blast system as the most desirable method. "This very interesting letter, comments Mr. Randolph, "unfortunately brings in the question of ventilation which the writer has not yet investigated."

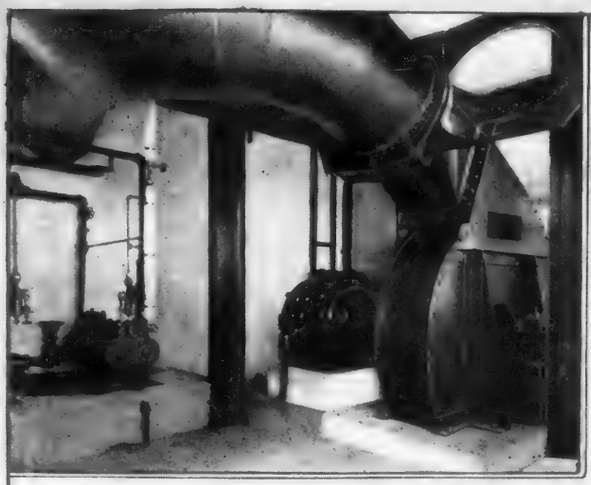
Ernest V. Lippe expresses the opinion that for mildness the water heating system cannot be improved upon. As to healthfulness he feels it is better than any direct-steam heating installation, but when compared with a temperate air supply system, this question becomes rather complex. He expresses the opinion that a fuel saving in an industrial plant will amount to at least 15% with a water heating system.

A. W. Moulder states that while his company (the Grinnell Company) are special pleaders for water heating, the experience of the company leads to the conclusion that water heating for industrial plants is in most cases very much more satisfacory than any type of steam system. On the point of mildness and healthfulness, Mr. Moulder quotes from a letter written by the Winton Engine Works of Cleveland, after its water heating plant had been in operation several years, to the effect that "the uniform temperature made possible by your system has contributed in a large measure to the satisfied feeling of our men which is evidenced by a very low labor turnover." As to elasticity of operation, Mr. Moulder states it as the company's experience that water heating systems are fully capable of meeting all of these conditions.

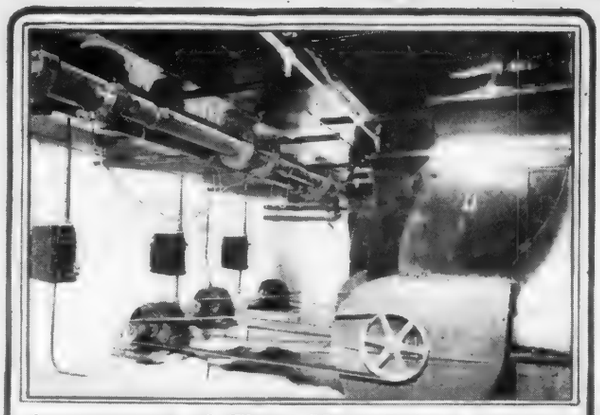
Speaking of facility of operation, Mr. Moulder mentions the point that the piping may be run at any elevation, so that trenches and returns under the floor are unnecessary. Piping may also be lowered or raised at will, which is often very advantageous in crossing monitors of buildings, etc. On the matter of economy of fuel, he gives this first place in the advantages of water heating. There

(*Continued on page* 66.)

Engineering Prog



Fan Pressure Blower System for Gas Works, Showing Heavy Metal Duct Construction Used.



Arrangement of Three Motor-Driven Exhaust Fans, Boston Store, Chicago.

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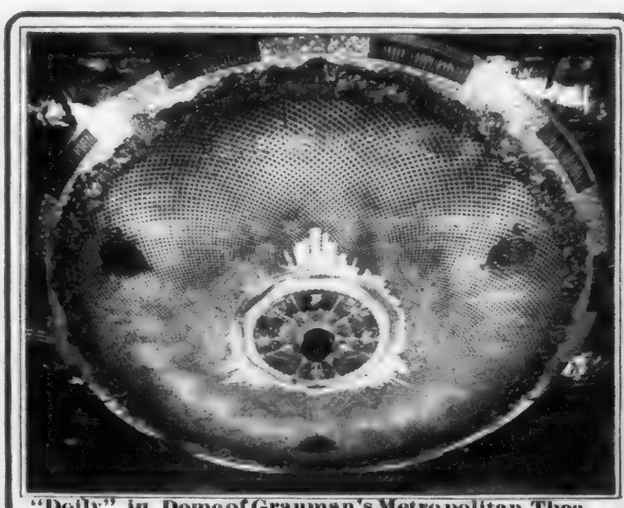
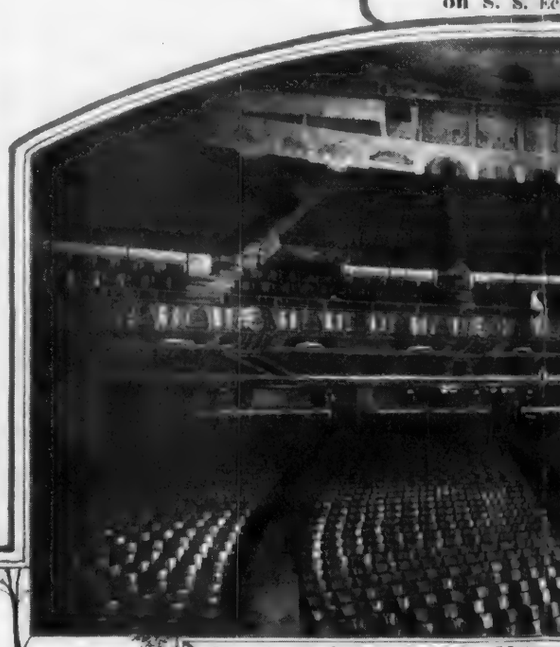


"Dolly" in Dome of Grauman's Metropolitan Theatre, Los Angeles, Through Which Air is Supplied to the Auditorium.



Interior of Grauman's Metrop
Stage, Showing Air Supply
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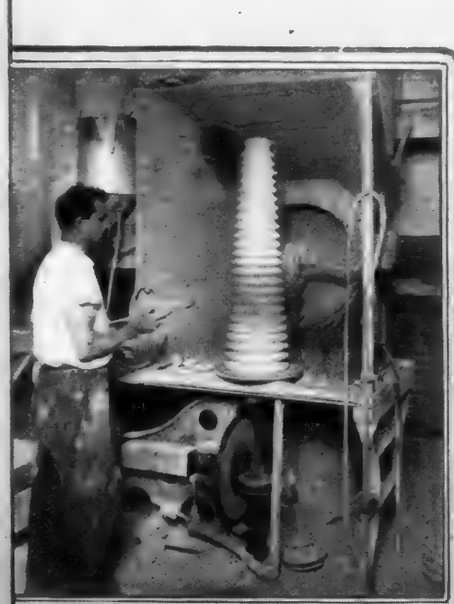
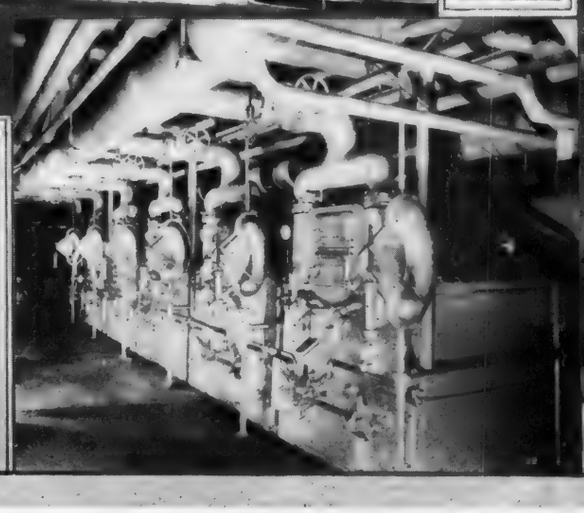


Exhaust Fan Used in Porcelain Work, Showing Workman Spraying Glaze on Large Insulator.



(Above) What the Public Sees When a Fine Residence is Built (Residence of Frank D. Stout, Chicago). (Below) Boiler Installation in the Same Residence Which the Public Never Sees.

Air Grille in One
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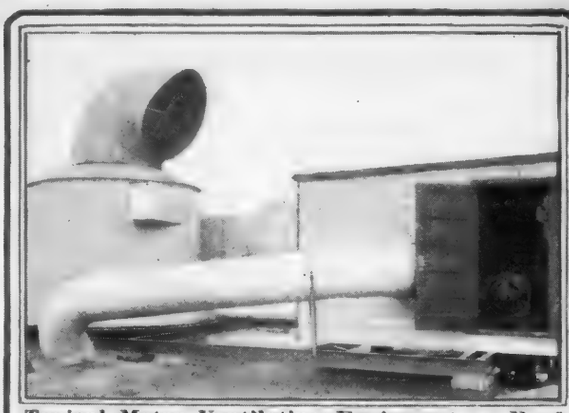
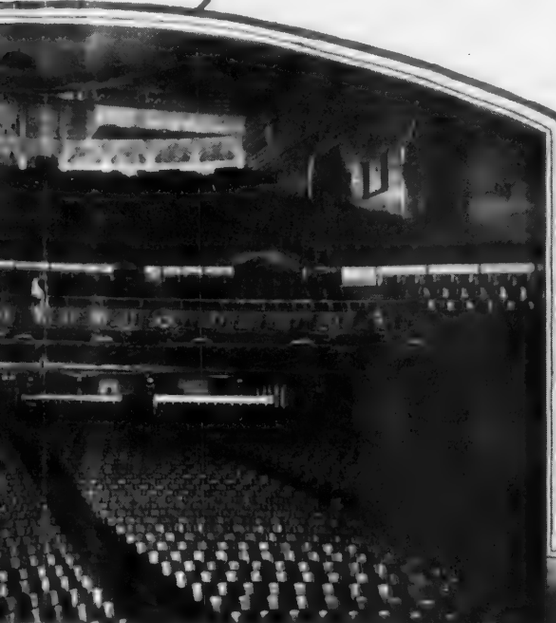


Typical Motor Ventilating Equipment on Roof of A. M. Creighton Shoe Factory, Lynn, Mass.

Young Carpenters in the Making, Carnegie Institute of Technology.



Metropolitan Theatre from the
Supply Grilles Beneath the Bal-
he Rail.

View of Apparatus Room, Grauman's Metropolitan Theatre, Los Angeles.

One of the Columns of
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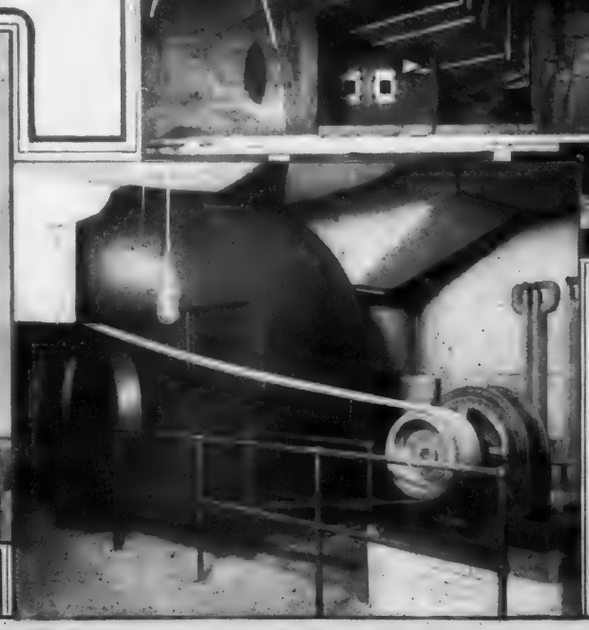
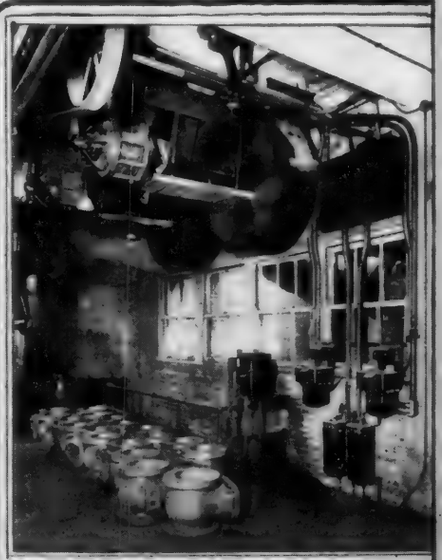


(Above) Glimpse of Sheet-Metal Work in Grauman's Metropolitan Theatre. (Below) Supply Fan in Bushwick High School, Brooklyn, N. Y.



Novel Installation of Exhausters in Crane Company's Plant, Chicago.

A Symposium on Hot Water Systems for Heating Industrial Plants

(*Continued from page 63.*)

is first of all, he says, economy right at the boiler, in case it is a direct-fired boiler system, as the difference in temperature between the average water and the products of combustion is much greater than with a steam system, thereby causing lower stack temperatures. As a main factor in economy, however, he mentions the ability to regulate the temperature of the water in proportion to the outside weather conditions.

Finally, on the point of economy of labor, he states that the life of a water heating system is very much greater than that of a steam system, due to the fact that the water is used over and over again, thus reducing the corrosion. He also mentions the absence of traps and other mechanical devices, as well as the fact that the valves are rarely used.

E. Vernon Hill states that "if you refer to hot water versus low-pressure steam, vacuum systems, blast heating systems, not including furnace equipment, I would say there was very little choice between them with regard to the five items you mention, with possibly some slight economy in favor of the vacuum steam. From a theoretical standpoint, as well as from practical experience, I cannot see where any difference in the various systems exists from a standpoint of mildness and healthfulness, in elasticity of operation or facility of installation, or economy of labor. It is true we find a very marked difference in different installations, but this is almost invariably due to the difference in design or installation of the various systems."

Mr. Randolph's comment on this is that, as he understands it, there would be but little difference between a vacuum steam system and an ordinary steam system, as regards elasticity of the heating medium and that, after all, is the basic reason why hot water seems to excel for industrial heating.

Herbert Foltz mentions his limited experience in the field of industrial plant heating, but states that in his case, the practice of installing steam heating systems in such plants is generally due to directions to keep the initial cost of the building within prescribed limits.

John Gormly writes: "No system of heating compares with water circulation when properly installed." Arthur Peabody writes that his department is using hot water in the Wisconsin State institutions, heated at each building by the general steam distribution system. This, he adds, avoids circulating hot water over extensive areas.

W. B. Graves states that there is positively no question regarding the value of water heating for either residences or large factory buildings over steam heating. He cites the case of the Western Electric plant, in Hawthorne, Ill., where forced circulation water heating system replaced a steam system. This plant, he states, during a period of five or six years, showed savings of many thousands of dollars every year in fuel alone. Similiar expressions were made by D. H. Cuyler, C. H. Blackall, Holyoke Davis, Leland Stanford Kemnitz, James Burke, and J. Monroe Hewlett.

Walter E. Gillham endorses the practice of heating with water, but points out that in southern climates, where heat is needed only in the morning and late afternoon, hot water is slow to heat up and takes too long to cool off. Also when extensions are made to plants, there is likely to be trouble. Mr. Randolph's comment on this latter point is that "if the original equipment has been properly laid out, I find there is no difficulty in making additions, as piping can be run either up or down without drainage provisions, as is, of course, necessary with steam systems."

Warren J. Davis writes in favor of water heating, as does F. F. Van Tuyl, and the Webster Cigar Company.

F. D. Mensing, commenting on the point of mildness and healthfulness, maintains that this can be obtained by either hot water, blown air, or steam. He also makes the point that the best condition of air for health, as has been brought out by the A. S. H. & V. E. Research Laboratory, will never be obtained by the use of radiation alone.

Regarding elasticity of operation, he states that this can also be maintained by ventilation and steam. Regarding facility of installation, he speaks of cases where ventilating systems have been installed much cheaper and much easier than could hot water. Economy of fuel he believes, depends entirely upon the type of building and other considerations. Summing up his opinions, he states that the type of heating system to be installed varies with the structure, the material to be manufactured, the layout of the plant (topographical), money available, and numerous other considerations.

Albert Kahn writes that in nearly all cases water heating systems are installed in buildings designed by his office where the height is not excessive. Finally Donn Barber and Professor Howell M. Gano, express their preference for hot water.

Henry H. Kendall brings up the point that with hot water, it is not so easy to quickly change the temperature when the building becomes overheated. Mr. Randolph's comment on this is that it is also true that in the case of hot water overheating very seldom occurs.

The letter from the English correspondent, D. M. Nesbitt, must have come as a shock because instead of endorsing the prevailing English practice of heating with hot water, Mr. Nesbitt presented a detailed argument in favor of steam, particularly the Nuvacuumette system which his company controls.

Practical Considerations in the Operation of Central Heating Plants

Responding to a question, propounded by *Power Plant Engineering*, of Chicago, as to what conditions are necessary to make the proposition of supplying central heat profitable, some interesting replies are published from J. H. Walker, superintendent of central heating, Detroit Edison Co., Detroit, Mich.; R. D. DeWolf, chief operating engineer, Rochester Gas & Electric Corporation, Rochester, N. Y.; and D. S. Boyden, superintendent steam heating service department, The Edison Electric Illuminating Co., Boston, Mass.

Mr. Walker, after referring to the advantages of utilizing the heat now wasted to the atmosphere in electrical generating plants, notes what he terms the underlying obstacle to the success of central heating enterprises which is, broadly speaking, the close competition offered by the isolated heating plant. The relative simplicity of producing heat upon the premises, at perhaps as low a cost as when furnished by an outside source, often impels a man to operate his own boiler plant.

"Many ventures in the central heating field," states Mr. Walker, "have been unsuccessful because of failure to foresee the development which has taken place and is still proceeding in the electrical industry. Small plants whose exhaust steam was used for heating has been absorbed by large power systems and their generating units shut down and the enforced continuation of the heating service on a live steam basis has been disastrous. Central heating should not be undertaken from a generating plant which may, under any probable future conditions, be robbed of its electric load."

Mr. DeWolf points out that in the combination of the heating business with the electric business, there are, generally speaking, three stages: financial; common management, where the heating company becomes a department of the parent company, although there is no physical combination of the plants; and common management and physical combination of the plant and other fixed assets.

Mr. DeWolf points out the advantages to to gained where conditions permit of the actual physical combination of the plants. As he states, the ideal situation would be one in which, through the combination of the electrical and heating load, the boiler would normally be operating at or near the point of maximum efficiency, say, 150% of rating. Attention is also directed to the fact that where a plant is especially designed to carry a combined electrical and heating load, it can be built at a materially lower cost than that of two separate plants. He concludes with the statement that "with a rate system based on actual costs, there should be no question about the advisibility of combining the electrical and heating loads when the heating load is of such a character as to combine with the electric load to advantage and where the investment in the distributing system is not excessive."

Mr. Boyden, at the outset, points to the fact that to-day we find central heating plants used in practically all large public and privately-owned institutions, railroad terminals and industrial properties. In many of these cases the central plant was installed to replace a number of small isolated plants at a great expense for investment and replacement. The district heating business, he adds, has a distinct advantage in that it may select the area in which it will supply its steam and fix the prices which shall be charged. Mr. Boyden emphasizes the necessity of selecting logical areas, of making conservative estimates, of obtaining suitable rates and of providing adequate financing. "The fundamental advantage of district heating," he states, "is certainty of service and convenience and it it not necessary that this service compete with the actual operating cost of the isolated plant."

New Fuel-Oil Rules For New York City

Amendments Adopted by the Board of Standards and Appeals, Dealing with the Construction and Installation of Oil-Burning Equipment and Storage and Use of Fuel-Oil

FOLLOWING are the requirements incorporated in the amended fuel-oil rules which were finally adopted January 18, 1924, by the New York City Board of Standards and Appeals. These rules are now in effect.

Fuel-oil is defined in these rules as any liquid or mobile mixture, substance or compound derived from or including petroleum, which does not emit an inflammable vapor below 135° F., when tested in a Tagliabue or Pensky-Martens closed cup tester. Such oil is classified as either Grade A or Grade B fuel-oil.

Grade A fuel-oil is that which shows a minimum flash point of not less than 150° F.; Grade B fuel-oil is that which shows a flash point of not less than 135° F

Grade A Fuel-Oil

Grade A fuel-oil, to be used for commercial, heating and power purposes, must at all times be contained in metal tanks with all openings or connections through the tops of the tanks. In all buildings fuel-oil storage tanks must be buried below the floor of the lowest story, except under extraordinary conditions. Along the line of subways no tank may be placed within 20 ft. of the wall separating the building from the subway. If practical, tanks must be placed in a lower position than the roadbed of the subway.

Commenting upon the new fuel-oil rules adopted for New York City, Chairman W. E. Walsh, of the Board of Standards and Appeals, writes: "The rules have been rearranged so as to specify more particularly the requirements for Grade A and Grade B fuel-oil under separate headings. The use of welded tanks is permitted and specifications as to the construction of tanks have been incorporated. Also the use of Grade B fuel-oil, under certain restrictions, in multi-family houses, has been permitted."

LOCATION AND CAPACITY OF TANKS FOR GRADE A FUEL-OIL

When tanks are to be placed inside buildings above ground, they must be placed in an enclosure, the walls, floor and roof of which shall be of reinforced concrete not less than 8 in. thick, or 12 in. of masonry, and of dimensions 6 in. greater on all sides than the outside dimensions of the tank. The walls of the enclosure are to be carried up at least 1 ft. above the tank and roofed over with reinforced concrete or similar construction capable of sustaining a load of 300 lbs. per square foot. The roof of every enclosure must have a manhole with fireproof cover, properly weighted, but not fastened, placed immediately above the manhole in the top of the tank. A space of at least 2 ft. must be maintained between the top of the roof of the enclosure and the ceiling immediately above.

The space surrounding the tank formed by the enclosure walls and roof must be completely filled with dry sand or earth, well tamped. Not more than one tank can be placed in an enclosure and in non-fireproof or frame buildings, the total storage capacity of the tanks shall not exceed 5,000 gal., except that where tanks properly enclosed or covered are located in a fireproof or detached room which is cut off from the rest of the building vertically and horizontally and if such room is adequately ventilated to the outside air, the total storage capacity may be as high as 50,000 gal., with an individual tank capacity not exceeding 20,000 gal.

TANKS INSIDE BUILDINGS BELOW GROUND

When tanks are to be placed inside buildings below the ground, their capacity may be increased 100% over the figures given above. Care must be taken to bury tanks below the level of any piping to which they may be connected, with the tops of the tanks not less than 2 ft. below the surface of the ground. In lieu of the 2-ft. cover of earth, tanks may be buried under 12 in. of earth, well tamped, covered with at least 6 in. of concrete which shall extend at least 1 ft. beyond the horizontal outline of tanks in all directions. Where necessary to prevent floating, tanks must be securely anchored.

Tanks must be set on concrete or metal cradles placed on a firm foundation and surrounded with soft earth or sand. Tanks must be completely encased with 6 in. of concrete where soil conditions require.

VERTICAL TANKS OUTSIDE OF BUILDINGS ABOVE GROUND

For the installation of tanks outside of buildings above ground, where they are of the vertical type of 150,000 gal. capacity or less, the tanks must be not less than 1¼ tank diameters and in no case less than 10 ft. from the line of adjoining property, or the nearest building or adjacent tank. Where such conditions now exist, it is provided that a fire wall shall be built to a height at least 2 ft. above that of the highest tank, completely separating the tanks for their full diameters or lengths. Firm foundations must be provided, with supports of fireproof materials. All tanks should be electrically grounded.

TANKS OUTSIDE OF BUILDINGS BELOW GROUND

Tanks placed outside of buildings below ground must be buried below the level of any piping to which they may be connected, with the tops of the tanks not less than 2 ft. below the surface of the ground, or, in lieu of this earth covering, they may be buried under 12 in. of earth, covered by at least 6 in. of concrete which shall extend at least 1 ft. beyond the horizontal outline of tanks in all directions. Where necessary to prevent floating, tanks must be securely anchored. Tanks must be set on concrete or metal cradles on a firm foundation and surrounded with soft earth or sand, well tamped. Where soil conditions require, tanks must be completely encased with 6 in. of concrete.

MATERIAL AND CONSTRUCTION OF TANKS FOR GRADE A FUEL-OIL

Detailed rules are included covering the material and construction of tanks for the storage of Grade A fuel-

oil. These rules apply to both cylindrical tanks (except vertical tanks located outside of buildings above ground), rectangular tanks, vertical storage tanks located outside of buildings above ground, and welding.

All tanks for the storage of fuel-oil must be built of steel plates made by the open-hearth process and known to the trade as tank steel. The thickness of steel required and the size and spacing of rivets must be as stated in the table given in the rules. If rectangular tanks are used, they must be built of the same quality of steel plates as specified for cylindrical tanks and must have a thickness of steel of not less than 5/16 in. Corners may be made up by bending the plates or by the use of angles at the builder's option.

The rules regarding welding provide that all welded seams of plates shall be lapped or butted. When the joint is lapped, the sheet must be lapped not less than 2 in. and welded both inside and out. Where a butt joint is used, it must be of the 90° double-V type, welded both inside and out and reinforced to a total thickness of at least 1½ times the plate thickness. Where tanks are made up of two or more rings the welded longitudinal joints of adjacent sections shall break joints. At no point of a butt girth joint shall the sheet on one side be offset with the sheet on the other side in excess of one-half the thickness of the plate. All butt girth joints shall be welded inside and out and reinforced to at least one and one-half times the plate thickness, except that for tanks of 1100 gal. capacity or less and not over 48 in. diameter, in which they may be of the same construction as the head seams, for which rules are given.

For rust proofing, it is provided that all tanks must be thoroughly coated on the outside with tar asphaltum or other suitable rust-resisting material. Where soil contains corrosive substances, special protection may be required. Care must be taken not to coat the tanks until after the necessary tests have been made.

All tanks must be vented. In this connection it is provided that an open, galvanized-iron vent pipe without trap and draining to the tank shall be provided for each tank. The lower end of the vent pipe must not extend through the top of the tank more than 1 in. Where a battery of tanks designed to hold the same class of liquids is installed, vent pipes may be run into a main header. Connections to the header must be not less than 1 ft. above the level of the top of the highest reservoir from which the tanks may be filled. The main vent pipe from the header must be screened. The main vent pipe and header must be of an area equal to the aggregate area of the vent pipes connected thereto. Vent openings shall be screened by 40-mesh non-corrodible wire screen and shall be of sufficient area to permit proper inflow of liquids during the filling operation and 2 in. in diameter on all tanks above 1100 gal. capacity, and in no case to be less than 1¼ in. in diameter.

Vent pipes must be provided with weather-proof hoods and terminate outside the building above the street surface, not less than 6 in. nor more than 12 ft. above the fill pipe. Such vent outlet shall not be located within 3 ft. in any direction of a window or other opening, or an exterior stairway, or fire escape, nor shall vent pipes be placed in elevator or dumb-waiter shafts, or in an enclosed port.

If compelled, because of structural conditions, to carry the vent outlet higher than 12 ft. above the fill box, and if the fill box lines are connected to tank trucks by tight connections and filled by pressure, a 1-in. line shall be connected to tank and shall parallel the fill lines and terminate in the fill box with unthreaded end. A check valve shall be installed in the line so as to permit excess oil in the tank to flow to the fill box and shall be so set as to prevent the passage of vapor to the street.

Manhole covers may be of cast-iron, cast-steel or of the same material as used in the construction of the tanks. On tanks placed inside buildings, the manhole shall be bolted or otherwise secured to the tank and made gas-tight. All tanks over 1100 gal. capacity shall be provided with a manhole of at least 11 in. x 6 in.

ENCLOSURE AND PROTECTION OF TANKS FOR GRADE A FUEL-OIL

Above-ground storage tanks must be protected by an embankment or a dike. Such protection shall have a capacity of not less than 1½ times the capacity of the tank so surrounded, and shall be at least 4 ft. high, but in no case higher than ¼ the height of the tank when the height of the tank exceeds 16 ft.

Embankment or dikes shall be made of earthwork, with clay core; masonry or impervious reinforced concrete. Earthwork embankments must have a flat section at top of not less than 3 ft. and a slope of at least 1½ to 1 on both sides. Concrete or masonry dikes shall be designed as to safely carry the entire volume of the oil in the tank so surrounded.

Embankments or dikes must be continuous and unpierced. Piping must be carried over or under them in such a manner as not to interfer with the efficiency of the enclosure.

Fire-extinguishing equipment must be provided for every tank with a capacity of over 5,000 gal. inside of buildings and 10,200 gal. outside of buildings, this equipment to consist of a system of steam pipes, blanketing gas or other approved system for use in case of fire. When steam is used, the steam supply pipe shall be not less than ½ in. in size. The boilers shall be conveniently located and the steam to the extinguisher lines shall be controlled by easily accessible valves.

Near each boiler of fuel-oil burning equipment there shall be kept ready for use a hand fire extinguisher of not less than 2 quarts capacity suitable for extinguishing oil fires.

Tests of tanks are provided for. Those inside of buildings or outside below ground must withstand a hydrostatic test for at least 30 min. and show no leaks. The hydrostatic test pressure shall be not less than 30 lbs. per square inch for welded tanks, nor less than 25 lbs. per square inch for riveted tanks. For horizontal tanks outside above ground, the hydrostatic test pressure is fixed at 25 lbs. per square inch and the duration of test 30 min.

Vertical tanks outside of buildings above ground, having a cover of lighter material than that of the sides of the tank must withstand a head of water equal to that of the depth of the tank.

Tests are to be conducted in the presence of a representative of the Fire Commissioner and the contractor is to furnish all the equipment necessary for conducting the tests. Access to the inside and outside of tanks

must be maintained until the necessary tests are completed.

Welded tanks must be subjected, during the tests, to a thorough hammer or impact test.

PIPING FOR GRADE A FUEL-OIL

Piping is to be run as directly as possible, without sags and shall be laid so that, where practicable, pipes shall pitch toward the supply pipe without traps. Pumps, however, may be located below the top of the oil storage tank or tanks where heavy oil is used having a gravity of not more than 18° Baumé and where the top of the tank or tanks is not more than 10 ft. above the pump or pumps. Provision must be made in the piping installation for expansion, contraction, jarring and vibration. Cross connections permitting gravity flow from one tank to another are prohibited. Pipes conveying oil, if laid inside a building, shall be either buried or exposed to view. Where piping is exposed, it shall be easily accessible for inspection at all times and protected against injury. Exposed piping shall be hung or supported on fireproof materials to prevent falling in case of fire. Piping laid below ground or subject to corrosion must be protected.

All piping must be of standard full weight brass, wrought-iron or steel, for working pressures less than 100 lbs.; for working pressures above 100 lbs., extra-heavy seamless drawn tubing and drop-forge fittings must be used. No pipe less than ½ in. inside diameter will be permitted. All connections must be tight and have well-fitted joints. Hose and couplings, where used in connection with mechanical burners, must be capable of withstanding a pressure equal to the piping to which it is connected and shall be constructed of fire-resisting materials. Hose must be no longer than necessary.

Tests at a hydrostatic pressure of not less than 150 lbs. per square inch must be made of piping for systems with working pressures under 100 lbs., after installation. Where the working pressure exceeds 100 lbs., the hydrostatic pressure for the test must be not less than 1½ times the maximum working pressure. The maximum working pressure must be noted on the plans. In each case the tests are to continue 30 minutes.

Automatic pressure relief valves must be provided for all piping or heaters which can be separated from the source of supply and in which a dangerous pressure can be generated, either by the action of the pump or by steam. Such relief valve must discharge into the storage tank or into the suction line, provided there are no shut-off valves in the suction line between the pressure-relief valve discharge connection and the storage tank. No valves can be installed in the safety valve lines. In addition, an automatic by-pass valve of size equivalent to that of the discharge line must be installed between each pump and the first discharge shut-off valve. The automatic by-pass valve must discharge into the suction line near the pump, or into the storage tank, as described above. Care must be taken in the design of the setting mechanism to prevent the complete closing of the valve.

A separate fill pipe must be provided for each fuel-oil tank and care must be taken to keep the fill pipes as far as possible from any building opening. The receiver terminal of each fill pipe must be located in a tight metal box or casing provided with means for locking. The delivery terminal is to be connected through the top of the tank. A trap or seal for each fill pipe must be provided, carried within 4 in. of the lowest point in the tank. Either screwed or flanged fittings may be used in making up the fill pipes.

Return lines from burners, where necessary, shall be not less than the diameter of the supply line to the burner. These lines must be run as direct as possible and must be connected into the suction line near the pump or into the storage tank. No oil can be returned to the storage tank at a temperature higher than 140° F.

All heating to reduce viscosity of trade A fuel-oils in storage tanks in any building must be only by means of hot water coils, thermostatically controlled and the oil must not be heated above 140° F.

VALVES AND CONTROL OF FLOW FOR GRADE A FUEL-OIL

Control valves at the burners must be of a substantial type, provided with a stuffing box containing a removable cupped gland designed to compress against the valve stem and so arranged to facilitate removal. Valves must be designed to close against the supply and to prevent withdrawal of the stem by continued operation of the hand wheel. The use of packing which may be affected by oil or heat is prohibited.

A shut-off valve must be provided on both sides of each strainer in the discharge and suction lines near each pump; in the discharge line from each tank as near the tank as practicable, and in branch lines near each burner. An outside readily accessible valve must also be provided in all supply lines entering buildings from tanks.

A test well or gauging device must be installed, so designed to prevent the escape of oil or vapor within the building. The top of the well, when located outside of a building, must be sealed and kept locked when not in use.

PUMPS FOR GRADE A FUEL-OIL

All pumps must be of standard types approved by the Board of Standards and Appeals. They must be installed in duplicate where fire-protection equipment is dependent on the use of fuel-oil for heating or steam. When pumps are located in the same room where burners are installed, remote control must be provided. Pumps used in connection with outside above-ground storage tanks, must be located outside embankment walls, and where they will be accessible at all times, even if the oil in the tank or reservoir should be on fire.

Pumps may be located below the top of the oil storage tank where heavy oil is used having a gravity of not more than 18° Baumé, and where the top of the tank or tanks is not more than 10 ft. above the pump or pumps.

The burner mechanism must also be of a type approved by the Board of Standards and Appeals.

Thermometers placed in thermometer walls, with screwed top connections, must be installed at convenient and prominent positions in the oil supply pipe lines, between the service tank and the pumps, and also between the pumps and the burner, to indicate the temperature of the oil.

No fuel-oil burning plant, using Grade A fuel-oil, may be operated unless in charge of a person holding a

certificate of qualification from the Police Commissioner. Also, a permit from the Police Commissioner is required before a fuel-oil system can be operated or oil placed in the system. Plans for each fuel-oil system must be submitted to the Fire Commissioner, together with a certificate of the Superintendent of Buildings, indicating that the proposed construction of the enclosure and the location of the tanks is in accordance with the requirements of the Building Code and these rules.

Systems fed by gravity or force systems are prohibited where Grade A fuel-oil is used.

Grade B Fuel Oil

Grade B fuel-oil to be used for domestic heating purposes, where stored, must be at all times contained in closed metal tanks. Storage tanks shall preferably be buried either outside of a building or below the lowest floor level. When located inside of a building and on the lowest floor level, the aggregate capacity of such storage tanks shall be enclosed in 4 in. of terra cotta or 8 in. of approved masonry.

Tanks must be buried with their tops not less than 2 ft. below the surface of the ground and below the level of any piping to which the tanks may be connected, except that, in lieu of the 2-ft. earth cover, tanks may be buried under 12 in. of earth and a cover of reinforced concrete at least 6 in. thick, extending at least 1 ft. beyond the horizontal outline of tank in all directions; concrete slab to be set on a firm, well-tamped earth foundation.

Tanks must be set on a firm foundation and surrounded with soft earth or sand. Tanks must be completely encased with 6 in. of concrete where soil conditions require. Their capacity must not exceed 1100 gal.

Tanks for Grade B fuel-oil must be constructed in accordance with the rules for Grade A tanks. However, auxiliary supply tanks of 60 gal. or less capacity may be constructed of brass, copper, steel or wrought-iron of not less than No. 14 U. S. gauge. Tanks of a capacity of over 60 gal. and not more than 550 gal. must be constructed of steel not less than 3/16 in. in thickness.

Tests for Grade B fuel-oil tanks are to be made with a hydrostatic pressure of not less than 25 lbs. per square inch and the tests are to continue at least 30 minutes.

Auxiliary tanks for Grade B fuel-oil may be of the gravity type, if suitable automatic safeguards to prevent abnormal discharge of oil at the burner are provided. The total capacity of such tank or tanks in any building must not exceed 60 gal. Such tanks cannot be located within 10 ft. of any fire or flame and, where practicable, shall be placed at an interior angle of the cellar, formed by the walls of the building. They must be supported on metal frame or cradle and secured by 2 x ⅛-in. straps riveted or bolted to frame an dfastened to wall of building by rigid metal braces.

Gauging devices or test wells, the breakage of which would permit the escape of oil or vapor within the building are prohibited. The top of the well, when located outside of a building, must be sealed and kept locked when not in use.

The same requirement applies for the oil-level indicating device as for Grade A fuel-oil.

Oil pumps used for supplying oil to the burners must be rigidly fastened in place and secure against leaks. In other respects they must be of approved design, as for Grade A fuel-oil.

Piping for Grade B fuel-oil must be of standard full-weight brass, wrought-iron or steel. The supply pipe must be not less than ¼ in. in diameter, iron pipe size. All piping is to be buried as far as practicable. All connections must be tight and have well-fitted joints. Hose and couplings, where used in connection with mechanical burners, must be able to withstand a pressure equal to the piping to which they are connected and must be constructed of fire-resisting materials. Hose must be no longer than necessary.

Tests of all piping after installation are to be made with a hydrostatic pressure of 100 lbs. per square inch.

The rules for fill pipes and vent pipes follow those for Grade A fuel-oil installations.

Overflow pipes from burners and auxiliary tanks must not be less than one size larger than the supply pipe.

VALVES AND CONTROL OF FLOW FOR GRADE B FUEL-OIL

Readily-accessible valves must be provided near each burner and in the suction line from each storage tank. The construction of these valves are as specified for Grade A fuel-oil installations. A remote control for shutting off the supply of oil to the burners must be provided. Also an automatic by-pass valve of a size equivalent to that of the discharge line must be installed between each pump and the first discharge shut-off valve. The automatic by-pass valve must discharge into the suction line near the pump or into the storage tank. This valve must be of non-corrosive material and designed so as to prevent its complete closing. Automatic by-pass valves must be set at 50% above the maximum working pressure.

Burners must be of standard type approved by the Board of Standards and Appeals and must be equipped with an overflow attachment to shut off the flow of oil to prevent flooding. Automatic systems must be so designed that the flame cannot be extinguished by operation of the automatic control valve. A pilot light of adequate intensity must be provided in each combustion chamber, so arranged as not to be easily extinguished.

REQUIREMENTS FOR HEATERS AND RANGES

Stoves, ranges, warm-air furnaces "or other devices" originally designed for use of fuel other than fuel-oil, cannot be used in connection with oil burners unless space in which vapors might collect are adequately vented. If used, they must be of such construction as to withstand the maximum temperature of which the oil-burning device to be installed is capable. No damper for closing more than 80% of the effective area of the flue is permitted in a smoke pipe or flue.

No combustible material may be stored within 10 ft. of a furnace door. Any woodwork, wooden lath and plaster partition or other combustible material within 4 ft. of the sides or back, or 8 ft. from the front of the furnace shall be covered with approved plaster board or other approved incombustible material. Above the furnace there must be constructed a ceiling consisting of plaster board, covered with 26 U. S. gauge sheet metal, or ¾-in. of Portland cement plaster on metal lath; said ceiling to extend 4 ft. beyond the sides and back and 8 ft. from the front.

Near the furnace and so located as to be convenient

for use in emergency, there shall be provided a hand fire extinguisher of an approved type suitable for use on oil fires.

The rules regarding instruction cards and regarding installation are the same as for Grade A fuel-oil installations.

WHERE THE USE OF GRADE B FUEL-OIL IS PERMITTED

Grade B fuel-oil, within the meaning of these rules, shall be used for domestic heating in buildings occupied by not more than two families. In buildings with more than two families or in commercial plants a Certificate of Qualification is required. For buildings occupied by more than two families and in commercial plants the room or rooms in which the oil-conveying piping and equipment is installed must be cut off from the rest of the building by fireproof partitions, while the ceilings and floors must be constructed of not less than 8 in. for brick, not less than 6 in. for stone or cinder concrete, or hollow blocks of terra cotta, concrete or gypsum, and not less than 4 in. for stone or cinder concrete, if properly reinforced with steel, and such rooms must have direct entrance from the street only, and must be adequately ventilated direct to the open air.

SYSTEMS PROHIBITED WHERE GRADE B FUEL-OIL IS USED

The use of auxiliary tanks between pump and burner of the pressure type are prohibited. Systems, fed by gravity between the storage tank and the pump, or force systems, are prohibited.

USE OF GRADE A OR GRADE B FUEL-OIL

Every device and apparatus for burning Grade B fuel-oil must be approved by the Board of Standards and Appeals. Oils derived from or including petroleum that have a flashpoint below 135° F. cannot be used as a fuel to produce heat or light. However, the use of oil stoves, oil heaters or oil lamps commonly used for household purposes, which employ a wick to absorb such oil in its combustion, are not prohibited.

University of Illinois Short Course for Steamfitters and Plumbers

The short courses for steamfitters and plumbers, consisting of lectures and demonstrations, just concluded at the University of Illinois, College of Engineering, Urbana, Ill., met with even greater success this year than last year when the courses were inaugurated. The attendance increased from 126 to 209.

The courses are said to be the only ones of their kind in the world and those who attended were unanimous in asserting their great value. Several professors of the university's faculty gave their services without pay both years.

Among the courses offered which were of particular interest to heating men were the following:

Water heating system: test of a hot-water radiator with flow and return riser operating as in practice. A glass section was installed in the riser for observation purposes. The amount of heat given off by the radiator was measured, as well as the velocity and weight of water flowing in the system. This course was conducted by Professor F. E. Giesecke.

Professor A. C. Willard conducted a course on the flow of steam and water in heating systems, demonstrating the flow of steam and water in a one-pipe heating system to determine the critical velocity at which the steam picks up the water of condensation and carries it back to the radiator.

Radiator tests were conducted by Professor W. H. Severns to show the effect of bronzing a black-iron or rusty radiator, and also to show the relative value of the newer type of radiation, as compared with the usual standard type.

"Heat Losses from Various Surfaces" formed the subject of a course conducted by Professor V. S. Day and another course, under the direction of Professor A. P. Kratz, dealt with steam heating boiler tests.

Under hydraulics, pipe friction, measurements of water, pump tests, pipe thawing, meter tests and household and municipal water supply and sewage disposal were discussed.

New York's Coal Economy Show

A liberal education in the practice of economy through the use of the smaller sizes of anthracite coal is provided in the Coal Economy Show, now in progress at 13-15 East 45th Street, New York. The object of the exhibition, which is being given under the auspices of the General Committee of Anthracite Operators, is to demonstrate the advantages of using the smaller and cheaper sizes of anthracite for heating purposes. Several types of furnaces and grates, designed to burn the lower-priced coal, are shown. In addition, a motion-picture illustrating the development of the anthracite industry, from the formation of the coal, ages ago, down to its preparation for market, is shown every day at 12:30 and 4:00 p. m. There is also an interesting exhibition of photographs showing features of interest in the anthracite region.

Among the exhibitors at the show are: Coal Economies, Inc., Philadelphia; Greely Fuel & Engineering Corporation, New York, exhibiting the Greely stoker; Domestic Stoker Co., New York, exhibiting the Electric Furnace Man; Williamson Heater Co., Cincinnati, O.; Pyramid Iron Products Corporation, New York, exhibiting the Pyramid grate; Molby Boiler Co., New York, exhibiting the Molby magazine-feed boilers; L. J. Wing Mfg. Co., New York, exhibiting Wing forced draft blowers; Economy Grate & Equipment Co., New York, exhibiting the Economy water-cooled grate installed in an Ideal seven-section 48-in. boiler; the Culm Burn Equipment Co., represented by Wolff & Munier, New York, exhibiting the Culm Burn grate; Standard Heater Co., Williamsport, Pa., exhibiting the Spencer magazine-feed boiler; and the Minneapolis Heat Regulator Co., Minneapolis, Minn., exhibiting the Minneapolis line of heat-control devices.

Practical Use of the Earth as a Source of Heat

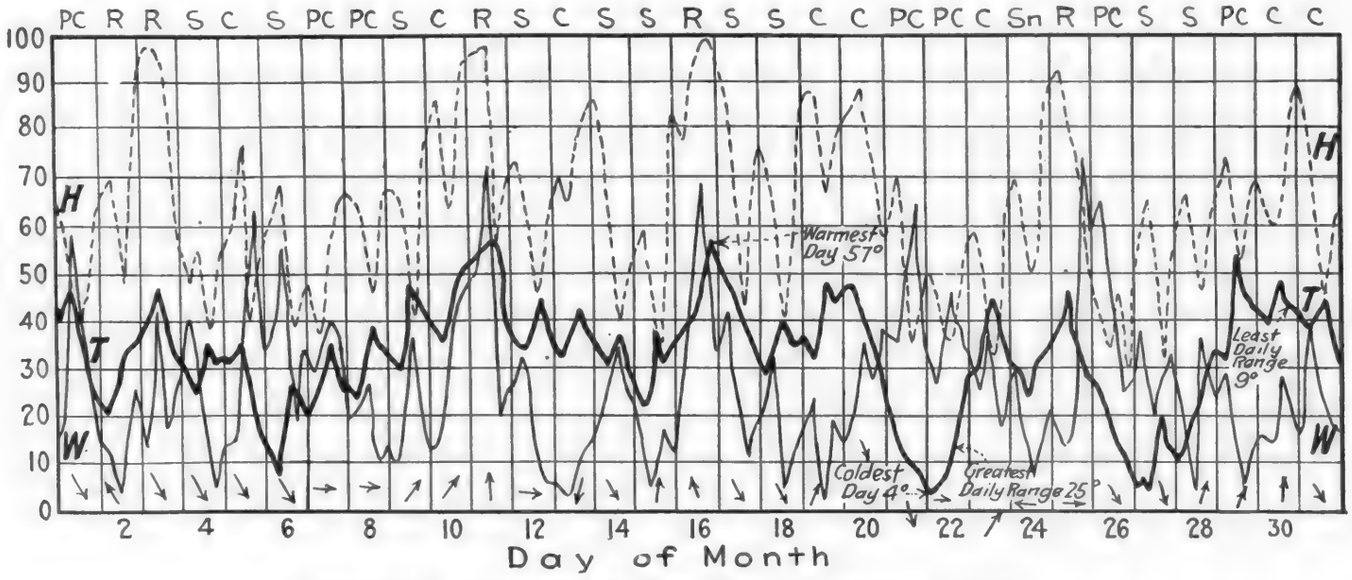
Incidental to a report prepared for the Bureau of Mines by Dr. Thomas T. Read, of the Department of Interior, on the cooling of air, Dr. Read states he does not believe it will be practicable to obtain steam power from the heated center of the earth. While granting that a region of high temperature would be reached, at a distance say of five miles below the surface of the earth, Dr. Read has concluded that the chief difficulty would be not the cost of penetrating to so great a depth (though a shaft five miles deep would cost $5,000,000 or more), but the fact that the amount of heat that can be derived from hot rock is not proportional to its temperature. Rather it is limited by the conductivity of the rock.

"The heat conductivity of rock is low" he states "and in order to get any considerable quantity of heat through in a unit of time the area of surface exposed must be large.

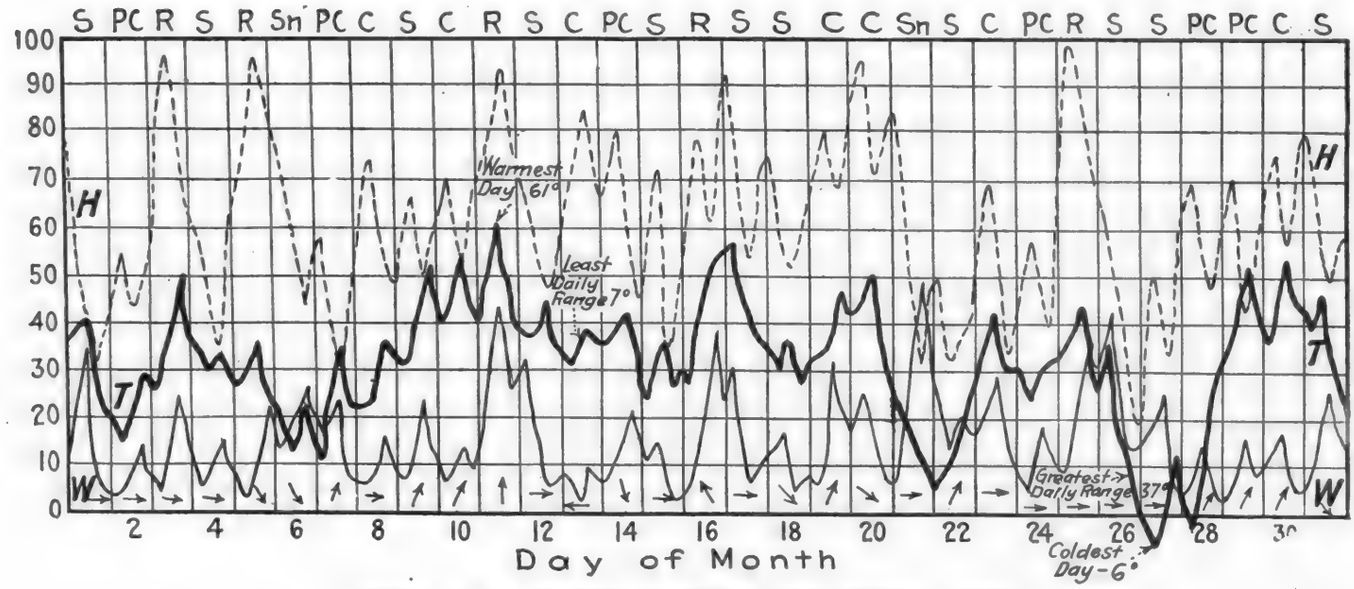
"A second important difficulty" he continues "depends on space; the heat is available five miles below the surface, but it can only be usefully employed on the surface. How to get it there without losing most of it on the way is the problem. One suggestion is to pass water down, and circulate it through large galleries at the bottom, thus giving it time to take up the heat, even at the slow rate of transfer that exists. This would give us water at a high temperature and pressure, but at the bottom of the shaft, where it is no more useful than ice is at the polar regions. In rising to the top of the shaft, the hot water would cool down at about the same rate as it heated in descending. Even with extremely efficient (and expensive) heat insulation on the up-going pipe, so much of the heat would be lost that what remained would not pay for the cost of getting it, at least until coal and other sources of power are much more expensive than they are now."

The Weather for January, 1924

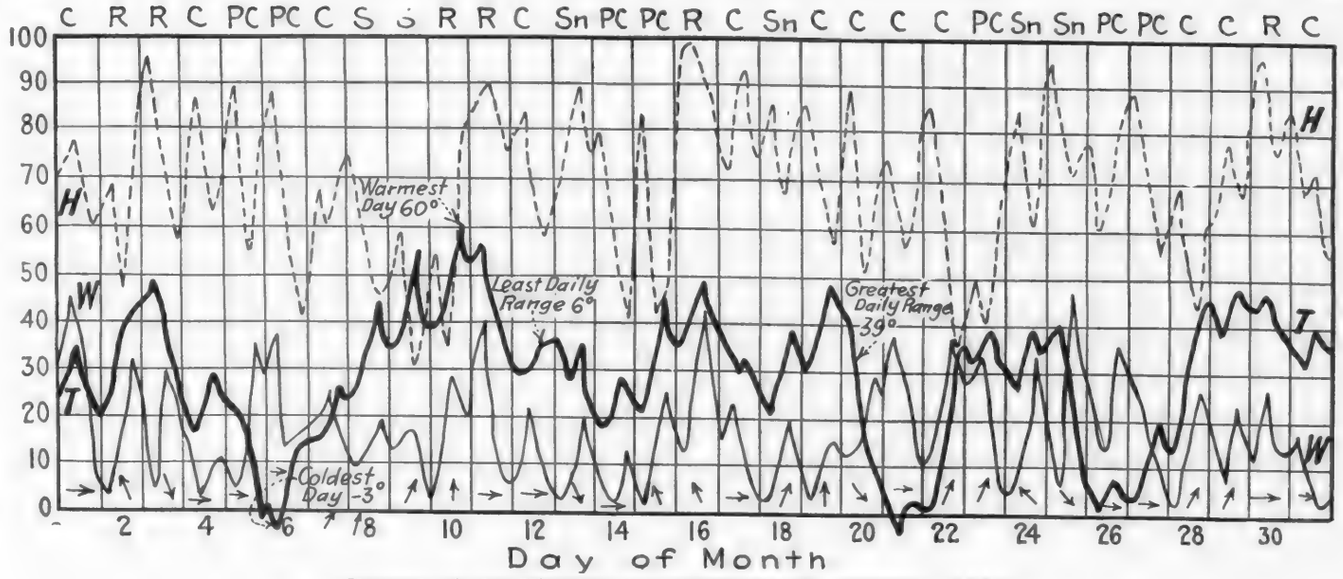
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	57	61	60	48	61
Date of highest temperature	16	11	10	9	8
Lowest temperature, deg. F.	4	—6	—3	-16	-11
Date of lowest temperature	22	27	6	5	5
Greatest daily range, deg. F.	25	37	30	37	34
Date of greatest daily range	22	26	20	6	6
Least daily range, deg. F.	9	7	6	5	6
Date of least daily range	30	13	12	23	11
Mean temp. for month, deg. F.	32.5	31.9	28.7	19.8	26.6
Normal mean temp. for month, deg. F.	30.9	27.8	30.5	25.1	30.8
Total precipitation, in.	3.56	3.27	3.53	1.32	1.15
Total snowfall, in.	2.5	8.5	1.3	5.7	3.9
Normal precipitation, this month, in.	3.70	3.82	2.87	2.0	2.27
Total wind movement for month, miles	16,924	9,171	13,545	9,394	10,323
Average velocity, miles per hour	22.7	12.3	14.2	12.6	13.9
Prevailing direction	N W	W	W	W	S
Number of clear days	10	12	2	11	13
Number of partly cloudy days	9	10	6	8	5
Number of cloudy days	12	9	23	12	13
Number of days with precipitation	6	7	10	9	13
Number of days with snow	1	4	5	8	5
Snow on ground at end of month, in.	None	None	None	None	None



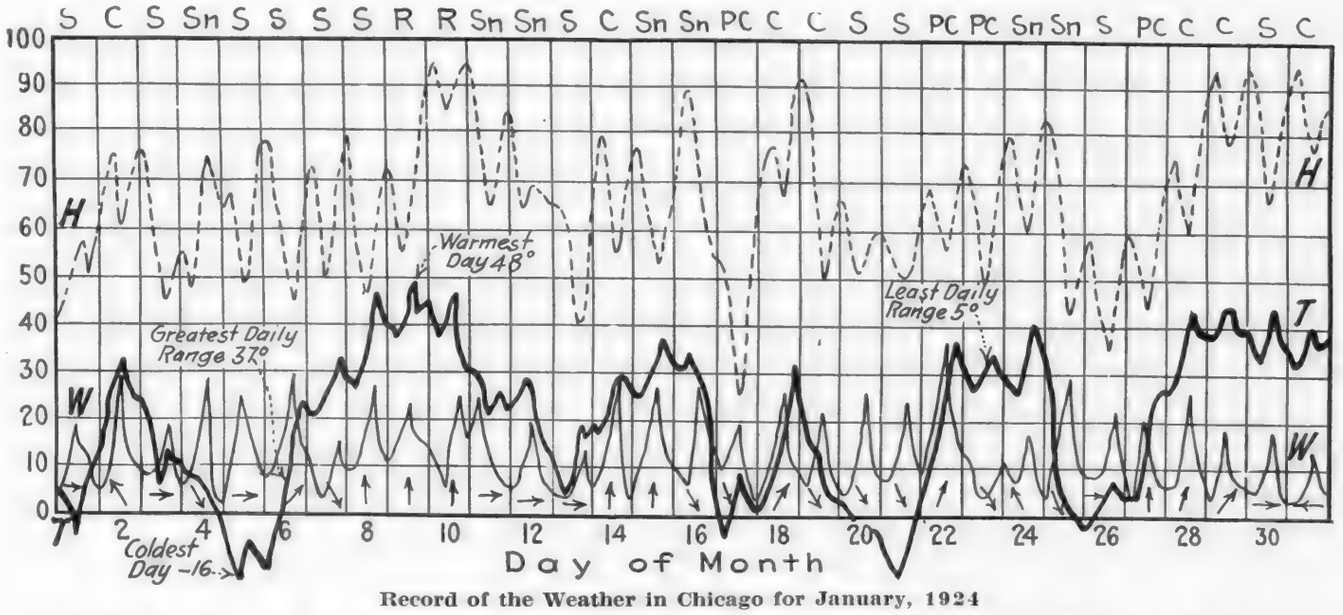
Record of the Weather in New York, for January, 1924



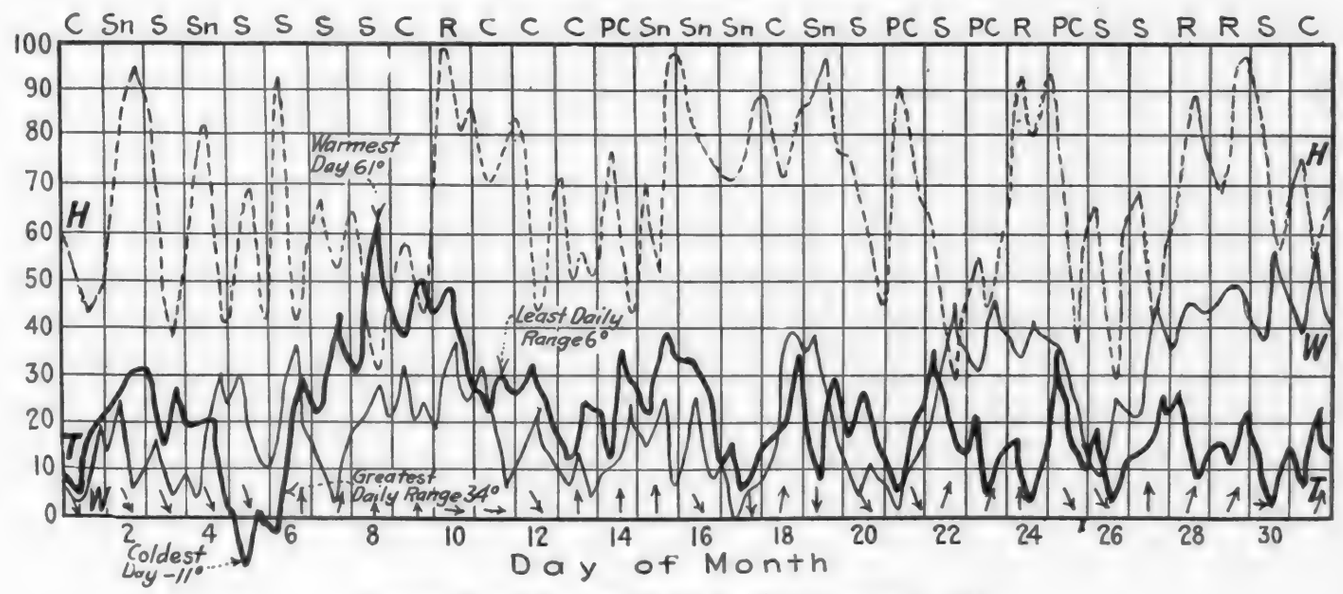
Record of the Weather in Boston for January, 1924



Record of the Weather in Pittsburgh for January, 1924



Record of the Weather in Chicago for January, 1924



Record of the Weather in St. Louis for January, 1924

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 A. M., 12 M., and 8 P. M.
S—Clear, PC—partly cloudy, C.—Cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.

American Society of Heating and Ventilating Engineers

Summer Meeting To Be Held in Kansas City.

Kansas City has been definitely selected by the council of the American Society of Heating and Ventilating Engineers as the place for holding the next semi-annual meeting of the society. The dates will be during the first week in June, 1924.

The New Secretary of the American Society of Heating and Ventilating Engineers.

As announced in last month's issue, F. C. Houghten, who has been in direct charge, under Dean F. Paul Anderson, of the investigations and tests at the society's Research Laboratory, in Pittsburgh, Pa., since 1920, has been elected secretary of the society. He took up his new duties early in February.

Mr. Houghten was a Bureau of Mines man before he became identified with the A. S. H. & V. E. Research Laboratory. From June, 1918 to October, 1920, he had charge of the Physical Laboratory at the Pittsburgh Experiment Station of the Bureau of Mines. Also, during this time, he supervised investigations of transmission of heat through boiler tubes and an investigation conducted by the Bureau, of heating and cooking devices used in the Army

The new secretary is a native of Troy, Mich., where he was born in 1888. He was graduated from Olivet College, Olivet, Mich., in 1913. From 1913 to 1915 he held a teaching fellowship in physics at the University of Washington. In 1915 he received the degree of master of science in physics and mathematics from the University of Washington. From 1915 to 1918 he taught science in the high schools of Ellenburg, Wash., and Hoquiam, Wash., coming directly from there to the Bureau of Mines Experiment Station.

Mr. Houghten will make his home in the New York district, where a warm welcome awaits his family, consisting of a wife and three children.

Endowment Plans for the A. S. H. & V. E. Research Laboratory

As was reported last month, steps are now under way for procuring an endowment for the Research Laboratory of the American Society of Heating and Ventilating Engineers which will insure its operation on a permanent basis. The actual drive for funds for such an endowment will probably be placed in the hands of some organization which makes a business of conducting drives. As was pointed out at the society's recent annual meeting, these concerns have access to the names of countless individuals who stand ready to help support such movements, as well as to funds which can be drawn on for this and similar purposes.

After such a scheme for financing the Research Laboratory had been discussed and offers had been made on the floor totaling $4800 to help pay the inital cost of an endowment drive, the meeting adopted the plan outlined in the following resolution:

"Whereas, the A. S. H. & V. E. has for five years carried on fundamental research on heating, ventilating and related subjects in its Laboratory at the Bureau of Mines, Pittsburgh, Pa. and

Whereas, the work is of such vital importance to the public health and in home heating and industry in its production and the health of labor; and

Whereas, it is deemed advisible to create an endowment fund which will perpetuate the work that has been started; therefore, be it

Resolved, That it is the sense of this meeting that:

1. A special committee be appointed by the president to investigate the practicability and means of securing such a fund.

2. That said committee consist of seven members of the A. S. H. & V. E., and to include one representative of the various outside organizations that may be expected to co-operate and to receive benefits from this work.

3. That said committee be authorized to solicit from our membership a loan of approximately $50,000, or as may be necessary to secure such an endowment fund. The amounts of this loan to be returnable to the contributors, without interest, when, in the opinion of the committee, the endowment fund has reached a goal that will be satisfactory to provide an income for the continuance of this work.

4. That this committee make a complete report and submit a plan in detail, not later than the Summer meeting of the society.

5. That this committee advise with our Research Committee on its budget and other matters of mutual interest.

6. That the plan submitted be approved by our Council, Research Committee and Endowment Fund Committee in conference."

Further Details of the New Hudson Vehicular Tunnel Given to New York Chapter.

Announcement that work on the Hudson Vehicular Tunnel was making such progress that one of its tubes is now two-thirds of the way under the river was made at the February meeting of the New York Chapter, held February 18, at the Building Trades Club, New York, when Ole Singstad, engineer of design for the Tunnel Commission, spoke on "Engineering Features of the Vehicular Tunnel." The speaker described in detail the method of ventilation finally decided upon whereby the air will be introduced at the road level through continuous slots, one on each side, and the vitiated air removed through gratings located at frequent intervals at the top of the tunnel.

Air to the extent of 3,000,000 cu. ft. per minute, he said, will be supplied through the four fan towers, two on each side of the river. This will give 40 air changes in the tunnel per hour. From tests, it is figured that the time taken for motor vehicles to pass through the tunnel, at 10 miles per hour, will be 10 min., but the air supply, Mr. Singstad said, will be sufficient to permit persons to remain at least an hour in the tunnel without ill effects. In addition, there will be a signaling system whereby all of the motor cars may be signaled to stop their engines in case of any serious blockade. For fire protection, the tube will be equipped with numerous hand fire extinguishers of the foam type placed every few feet along the entire length of the tunnel.

Mr. Singstad illustrated his talk with lantern slides showing the scheme used for tunneling under the river by the shield method. He also gave details of the experiments to determine the extent of gases to be expected which have been made by the Bureau of Mines, by Yale University and by the University of Illinois Eperiment Station.

After opening the meeting, President W. L. Durand turned over the gavel to A. A. Adler, chairman of the entertainment committee, who introduced the speaker. The attendance was one of the largest of the season.

Illinois Chapter Holds "Stunt" Night.

Details of peculiar experiences in heating work and the "stunts" performed to overcome the difficulties encountered were in order at the February meeting of the Illinois Chapter, held in Chicago, February 11. One of the troubles frequently encountered, it was brought out, is grease in boilers. The use of soda to eliminate the grease added, rather than reduced, the difficulties. The most effective remedy suggested was to blow out the boilers under a considerable pressure up to 20 lbs. The presence of the oil itself in tubular boiler was due, it was said, to the process used by manufacturers in cooling the pipes in oil.

Kansas City Chapter Hears Talk on Synthetic Air Chart as Applied Society's New Heating and Ventilating Code.

Dr. E. Vernon Hill, of Chicago, was the speaker of the evening at the February meeting of the Kansas City Chapter, which was held February 4, at the Kansas City Club. His address was devoted to the proposed new heating and ventilating code being compiled by the society. As chairman of the Sub-Committee on Ventilation Requirements, Dr. Hill devoted a large part of his remarks to the Synthetic Air Chart which has been tentatively adopted as the method by which the proper ventilation requirements will be determined. He felt that with good design, it would be easily possible to meet a percentage of "perfect ventilation" of 90% and that with elaborate refinements this could be increased to 95%. The attendance totaled 59 members and guests.

New Officers of Western New York Chapter

President Hugo F. Hutzel of the Western New York Chapter was duly installed at the February meeting of the chapter, at the Hotel Lafayette, Buffalo, February 11. The other officers are: First vice-president, Herman Worsham; second vice-president, War-

ren Hillis; treasurer, C. P. Wadley; secretary, Roswell Farnham. President Hutzel announced the appointment of a new program committee, consisting of C. W. Farrer, Herman Worsham and Frank B. Howell.

The speaker of the evening was A. H. Ballard, of New York, who spoke on "The Status of Domestic Oil Heating," supplementing his address at the recent annual meeting of the A. S. H. & V. E. in New York.

L. A. Harding, general chairman of the A. S. H. & V. E. Committee on Heating and Ventilating Code, gave the chapter an outline of the progress of work on the code and predicted a great future for the work when the code was completed and accepted by the society.

St. Louis Chapter.

Professor J. H. Kitchen was the principal speaker at the December meeting of the St. Louis Chapter, his address being devoted to the duty of the members toward the city of St. Louis. He emphasized the fact that in the pursuit of our daily business, we have fitted ourselves to help solve what are in reality the same kind of problems as those confronting the city, and that we should participate more actively in those affairs along lines on which we will be able to help.

Monthly Bulletin for National Warm Air Heating and Ventilating Association

National Warm Air Heating and Ventilating Association has issued the first number of a *Monthly Bulletin* designed to inform the membership of the organization's activities and accomplishments between meetings of the general membership. The initial issue is an four-page folder, attractively arranged and typographically pleasing. The new venture was authorized by the executive committee and will be continued until the next annual meeting when the membership will be asked to pass on the advisability of continuing it.

C. H. Lyman has been appointed to take the place of P. J. Dougherty as chairman of the Association's Research Advisory Committee. Announcement is made also that the first call for payments on the subscriptions to the association's Research Residence fund has met with a gratifying response. Detailed plans and specifications are being drawn and, it is hoped, the bulletin states, to let the contract for the $25,000 Research Residence, to be located at Urbana, Ill., at an early date. Certificates will be issued to each contributor when the final payments on the residence have been received.

Increased Dues for A. S. M. E. Members

The council of the American Society of Mechanical, Engineers is sending out a referendum ballot on increasing the dues of all grades except Juniors from $15 to $20. Juniors are to continue at $10. The continued depreciation of the dollar and the diversification of the society's responsibilities and activities produced by the ever-increasing membership and by the society's position in the profession, are given as fundamental reasons for the proposed increase.

Sixty-five local sections endorsed the council's decision to conduct the referendum at the recent annual meeting of the society.

1924 to Be Another $5,000,000,000 Building Year

Judging by the accuracy with which it predicted building activity in 1923, the new estimate made by the *Architectural Forum* in its Building Survey and Forecast for 1924 has special interest and significance. Last year, it will be recalled, this journal predicted a total building activity in 1923 of $5,116,554,000. The actual figures, according to estimates made by S. W. Straus & Company and by the Cooper and Brass Research Association, came to considerably over that figure.

TOTAL VALUE OF NEW BUILDING FORECASTED FOR 1924

BUILDING TYPES	N EASTERN STATES	N ATLANTIC STATES	S EASTERN STATES	S WESTERN STATES	MIDDLE STATES	WESTERN STATES	U S A
Automotive	$18,736,400	$47,916,700	$4,002,100	$8,878,400	$52,991,400	$13,798,100	$146,323,100
Banks	29,871,600	76,083,300	7,052,500	6,844,800	65,406,900	15,906,100	201,165,200
Apartments	33,445,900	198,849,500	18,333,400	22,183,600	170,214,800	125,822,800	568,850,000
Apartment Hotels	30,783,000	94,441,500	4,609,700	4,185,000	184,211,300	39,137,500	357,368,000
Clubs, Fraternal, etc.	22,955,500	68,528,600	13,826,000	20,711,100	148,896,100	38,929,800	313,847,100
Community, Memorial	3,022,500	25,472,700	1,553,100	8,484,700	20,797,900	22,471,900	81,802,800
Churches	21,461,300	74,982,800	15,338,800	26,861,500	103,763,200	46,766,600	289,174,200
Dwellings (Under $20,000)	17,471,600	99,677,400	8,463,000	16,169,600	60,477,900	24,992,200	227,251,700
" ($20,000 to $50,000)	11,736,600	46,655,000	5,359,900	9,650,300	31,610,700	9,176,000	114,188,500
" (Over $50,000)	8,726,500	29,549,200	1,953,000	7,021,500	17,558,400	10,750,800	75,559,400
Hotels	26,021,400	150,362,400	52,855,000	65,320,100	254,240,300	86,595,400	635,394,600
Hospitals	14,464,600	90,619,200	7,765,500	26,669,300	135,612,600	36,037,500	311,168,700
Industrial	35,008,300	157,941,900	10,567,900	10,645,400	165,633,000	36,316,500	416,113,000
Office Bldgs.	19,291,300	109,848,500	15,934,000	53,850,100	200,120,500	105,052,800	504,097,200
Public Bldgs.	9,827,000	20,537,500	6,060,500	24,700,800	60,747,600	25,271,200	147,144,600
Schools	77,937,100	203,325,900	43,285,300	44,038,600	334,831,000	98,840,400	802,258,300
Stores	7,554,700	34,552,600	3,828,500	4,901,100	68,094,600	21,262,900	140,194,400
Theaters	30,209,500	29,192,700	2,055,300	18,848,000	81,003,000	18,513,200	179,821,700
Welfare, Y.M.C.A., etc.	4,371,000	11,801,700	1,038,500	6,169,000	13,748,500	11,516,500	48,645,200
Total Value of New Buildings	$422,895,800	$1,570,339,100	$223,882,000	$386,132,900	$2,169,959,700	$787,158,200	$5,560,367,700

The new estimate is based upon reports obtained from 1668 architects covering projects in planning for 1924. The survey shows $500,000,000 better than 1923.

Certain offsetting conditions are reckoned on, such as the definite development of a buyers' strike which is expected to occur in the late Spring of 1924 if the great volume of building orders are placed at that time, and should bring about a considerable increase in prices. If this condition actually develops, it is stated, the figures for the latter half of 1924 will be smaller than anticipated. It is expected, unless prices go too high, that there will be a late reaction in the Fall of 1924. This, however, will still provide, during the year, two peaks of building activities, totalling more than $5,000,000,000 for the year.

Blue Penciled.

The Radiator, published by the St. Louis Chapter of the American Society of Heating and Ventilating Engineers, has the following item in its January issue:

BLUE PENCIL.

For many years the National Warm Air Heating and Ventilating Association and kindred organizations have been battling to uphold the standard of warm-air installations for the home, and it has been believed always that they had the support of our society. However, much to the RADIATOR'S surprise, there is found in the December, 1923 issue of *The Heating and Ventilating Magazine*, in the section devoted to the American Society of Heating and Ventilating Engineers, an article headed "Changing Over a Warm-Air Furnace from Coal to Gas," the following:

"It is not necessary to have any cold-air return pipes. Those in use can be removed, leaving the opening directly into the basement. Other cold-air inlets opening through the floor at strategic points can be made, if necessary. Both the furnace proper and the economizer will then take cold air directly from the basement and discharge it into the house. How much heat is to be allowed to radiate to the basement will have to be determined by trial. The heating will not be satisfactory if the temperature of the basement is allowed to remain more than 15° F. below the house temperature."

It is certain that this paragraph does not represent the opinion of our society and surely it cannot be the opinion of *The Heating and Ventilating Magazine*. The use of cold-air return pipes has long been an accepted standard both from a heating and ventilating standpoint, as well as sanitation,

ALLOCATION BY PERCENTAGE OF PUBLIC DEMAND FOR NEW BUILDINGS IN 1924

GEOGRAPHICAL DIVISIONS	Automotive	Banks	Apartments	Apartment Hotels	Clubs, Fraternal, etc	Community, Memorial	Churches	Dwellings (Under $20,000)	Dwellings ($20,000 to $50,000)	Dwellings (Over $50,000)	Hotels	Hospitals	Industrial	Office Buildings	Public Buildings	Schools	Stores	Theatres	Welfare, Y. M. C. A., etc
	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT
Northeastern States	4.4	6.9	8.1	7.2	5.4	.7	5.1	4.2	2.7	2.6	6.1	3.4	8.2	4.5	2.3	18.4	1.8	7	1
North Atlantic States	3.1	4.9	12.7	6.3	4.4	1.6	4.8	6.3	3.	1.8	9.5	5.7	10.1	7.	1.3	12.9	2.1	1.8	7
Southeastern States	1.8	3.2	8.2	2.1	6.1	.7	6.9	3.8	2.4	.9	23.6	3.4	4.7	7.1	2.7	19.1	1.8	1	5
Southwestern States	2.	1.8	6.	1.	6.	2.2	7.	4.2	2.5	1.9	15.9	6.9	2.8	13.1	6.4	11.4	1.3	6.9	1.7
Middle States	2.4	3.1	8.	8.5	6.8	.9	4.8	2.7	1.4	8	11.8	6.2	7.7	9.2	2.8	15.4	3.1	3.7	6
Western States	1.8	2.	16.	5.	4.9	2.8	5.9	3.2	1.2	1.3	11.	4.6	4.7	13.3	3.3	12.5	2.7	2.3	1.5
National Percentages, U. S. A.	2.6	3.7	9.8	5.	5.6	1.5	5.8	4.1	2.2	1.6	13.	5.	6.5	9.	3.1	15.	2.1	3.8	1

and to allow such a broad, flat statement to pass unchallenged would be a desertion of our accepted principles. It is to be regretted that the editor did not use the "blue pencil" on this article.

The article in question was one written by G. I. Vincent, manager of the Syracuse (N. Y.) Lighting Company, describing an arrangement whereby a warm-air furnace of the coal-burning type could be adapted to burn gas. It was presented originally before the American Gas Association at its convention in Atlantic City last Fall.

Of course the opinions expressed regarding the serviceability of return cold-air pipes and the practice of taking in cold air directly from the basement, rather than from out-of-doors, in connection with warm-air furnace heating systems, is simply the view of the writer of the article, and is not to be confused with editorial expressions. The editor's lot would be well nigh hopeless if he were obliged to sponsor all the statements made by contributors in the reading columns. At the same time, we feel *The Radiator* has done a service in "spiking" the basement cold-air intake idea. The gas people will have to reckon on standard practice in this respect in selling the heating industry on the use of gas house heaters of the warm-air type.

Speed Limits for Fans Used in Heating Ventilating Work

As is well known, the cup of the fan manufacturer would be full if he could design a fan for heating and ventilating work in such buildings as schools, theatres, auditoriums, etc., which could run efficiently and noiselessly at the high speeds desired when direct-connected to standard electric motors. In discussing this point in THE HEATING AND VENTILATING MAGAZINE for January, 1924, the statement was made in a paper by F. R. Still that "it has been determined by careful tests that these fans cannot safely be installed in buildings of the class above referred to (churches, schools, theatres, music halls or auditoriums) if the tip speed of the impeller has to exceed 6500 ft. per minute."

Fan manufacturers, however, are by no means agreed upon this point. For instance, at the same meeting of the New York Section of the American Institute of Electrical Engineers at which Mr. Still's paper was read, another paper was presented by C. A. Booth, of the Buffalo Forge Company, in which he told of the success which had been achieved in designing a fan blade which could be operated at speeds considerably higher than 6500 ft. per minute for this class of work. His discussion of this matter, which is now particularly apropos, is given herewith, in abstract:

"It is not so very long ago," he said, "that motors have been in nearly universal use for these ventilating systems, low-pressure steam engines having given satisfactory service for many years, until the wide application of the electric drive crowded them out. When motor drives for ventilating fans were first becoming general, the steel-plate fan, so-called, was in common use, with a speed which was much too low for direct-connection to motors, unless price and efficiency were to be entirely disregarded.

"With the introduction of the multiblade fan, the first step was taken for the increase in operating speeds, and it became possible to use direct drive, in many cases without requiring the resources of a State institution to underwrite the expense, but, even so, the operating speeds were far from being desirable to the motor manufacturer.

"Along with the introduction of the multiblade fan, engineers began to experience unforeseen difficulties in getting the results upon which their figures were based. Accustomed to design a system of distributing ducts and to select a fan with but one capacity rating for a given speed, they found that the multiblade fans then on the market were much more sensitive to operating conditions than the older forms of steel-plate fans, and instead of having the air delivered into the building within a very small percentage of what was expected, the systems were apt to fall far short, or to exceed the desired amount, with possible serious danger to the motors.

"The cause of this unforeseen difficulty was in the form of the pressure-volume characteristic possessed in common by all multiblade fans at that time on the market, and which had blades with a considerable forward curvature in the direction of rotation. These fans, with a shallow series of blades, developed a high velocity of air by impact, but a relatively small amount of static pressure, due to centrifugal action. For this reason the fan, if placed in a properly-designed housing in which the high velocity of the air leaving the tip of the wheel was converted into static pressure, would at normal rating operate efficiently, but had a strong tendency to overload or underload, should the resistance of the system be only slightly less or more than that developed by the fan at normal rating.

"It remained to find a fan which would have a pressure-volume characteristic more like the old steel-plate fan, but with the compactness and other desirable features of the multiblade type. Such a fan has been on the market for a number of years and satisfies most requirements for ventilating work. It is true that the operating speeds, in most cases, are not high enough to permit the use of standard motors coupled to fan shafts, although this may be done in the smaller sizes, while in larger units the motor frames required are much nearer those ordinarily used for belt-driven units of the same power, and the difficulties of design are therefore made simpler.

"When other conditions remain the same, the inclination of a centrifugal fan blade determines the velocity of air passing through it, hence with a fan wheel of given size operating at a certain speed and with blades of the same radial depth, to tip the outer edge of the blade backward, away from the direction of rotation, will cause a reduced velocity, that is, it will be necessary to operate the fan with backward-curved blades at a higher speed to produce the same velocity. Inasmuch as this velocity in converted into static pressure, the fan housing being identical in either case, the fan with backward-curved blades must operate at a higher speed, the speed difference depending on the inclination which may be secured without impairing the mechanical efficiency of the fan."

At another point Mr. Booth said: "When multiblade fans with forward-curved blades were first used, the increase in the number of noisy ventilating systems was at first laid to the higher speed at which these fans ran, but, in most cases, it was found that noise was due not to high fan speed, but to high velocity of air in the piping system, because of the tendency of fans of this type to overload and deliver air quantities in excess of the requirements. To specify fans at slower speeds would hardly cure the trouble if the fans still ran at critical pressures and the resistances of the systems were still overestimated. The double-curved blade was found not so sensitive to resistance vibration, and therefore to run closer to the predetermined capacity when changes in resistance occurred, so that the double-curved blade fan, besides being no more noisy inherently than a forward-curved blade fan, is less apt to overload and cause noise."

Mr. Booth presented a tabulation showing a comparison between the speeds of the two types of fans required to fulfill the architect's specifications as to air quantity and static pressure for the Statler Hotel, in Buffalo, in which Turbo Conoidal fan speeds ran uniformly higher than corresponding units of the Niagara Conoidal type, while the horse-powers ran uniformly less, with two exceptions. The high-speed fans as listed have been installed and operated for a number of months and Mr. Booth states that there is no perceptible noise, mechanical or otherwise, in any of the spaces which are ventilated. He points out that unusual care was taken in the design of the ventilating ducts and the installation of the apparatus.

Another tabulation covers a case where it was desired to use alternating-current motors and the use of high-speed fans for ventilation. Here it was possible to use direct connection, instead of geared drive, belted fans being out of the question. As in the previous table, the speeds of the double-curved fans ran uniformly higher than those of the forward-curved type, while the horse-powers, for the most part, ran lower. The cost for high-speed motors and gears came to $5931, while the cost for direct-connected motors came to $5982.

"The speeds," continued Mr. Booth, "were suitable for 60-cycle motors, and the cost of these low-speed motors proved to be almost identical with the cost of standard 60-cycle squirrel-cage motors, plus the cost of the gears."

Chicago's "Own-Your-Own-Home" Exposition

Plans of the "Own Your Own Home" Exposition in Chicago, March 22-29, call for the construction of two complete houses, equipped throughout with heating, ventilation, plumbing, electric wiring, etc., and properly furnished. Statistics will be available as to the cost of each piece of work and visitors will be given working drawings and specifications.

The exposition will be under the auspices of the Chicago Real Estate Board with William Zelosky chairman of the committee of administration.

Bacteria and Dust Control in Food Product Plants

By B. H. Thurman,
Manufacturing Manager, American Linseed Company.

IN the manufacture of food products, such as cheese, gelatin, oleomargarine, dried milk and ice cream, as well as in meat packing, milk pasterizing plants, bakeries, etc. it is most important that great care be exercised to insure clean air conditions in order to control not only the rejection of products, while still in process of manufacture, but to reduce to a minimum the rejection after reaching the retailer or consumer. Rancidity, moulds, and the general breaking down of products are all traceable to the presence of bacteria so that if bacteria can be eliminated a great saving would result for the manufacturer and there would be a minimum amount of rejection which now usually occurs weeks after shipments has been made. Even the use of benzoate of soda, which is permitted by the Government in small quantities, by no means off-sets the damage done by bacteria.

All air of course, contains dust particles and in congested areas the quantity runs very high. As is well known, dust is the medium for the transfer of bacteria. Food product plants have ideal conditions for the growth of bacteria and mould spores. Therefore in order to eliminate this growth it is necessary to control the air supply completely and clean it thoroughly, permitting no air to enter except through a properly designed ventilating system.

BACTERIA ELIMINATION AT NUCOA BUTTER PLANT

The Nucoa Butter Company, at the Bayonne Plant, has laid great stress on maintaining an unusally high degree of cleanliness but, irrespective of the care taken, it was found impossible to eliminate entirely bacteria and mould spores. After a thorough investigation of the situation the company decided to install a complete ventilating system, using an air filter of the so-called dry type and permitting no air into the plant except through this system.

The filter used is made up of a series of unit filters which consist of a channel iron frame and a cell. The channel iron frames measure 20in. x 20in. x 4in. thick and when bolted together in a bank form the structural support for the cells. Each frame is provided with slotted studs which pass through holes in the flange of the cells and the cells are held in place by means of tapered pins.

The cells are rectangular compartments made up with expanded metal front and back which hold in place the filtering media consisting of specially-drawn split wire. Both the cells and the frames are subjected to a special high-temperature enameling process which renders them resistant to corrosion due to oxidation or acid action.

This system of units provides a flexible arrangement which can be varied to suit specific conditions as to volume or space requirements.

Before being placed in the frames the cells are immersed in an adhesive fluid which coats the entire filtering media. After proper draining the cells are then made fast in the frames. The air passing through the filter is split up in an infinite number of sub currents by the filtering media and is caused to change its direction may times during its passage.

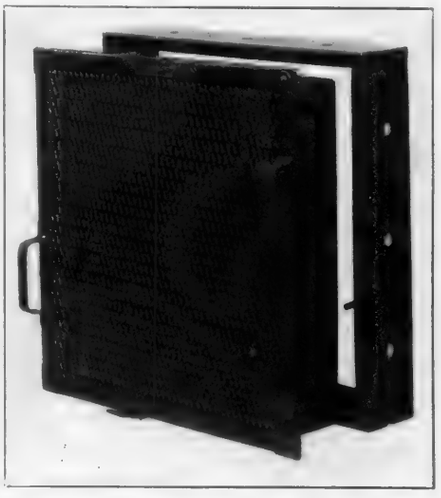
It is this constant changing of direction and impingement on the coated tendrils of the media that is depended upon to leach out the dust and bacteria and finally to permit the air to pass out free from all solids and contamination.

As the dust deposits on the filtering media it become coated with the adhesive fluid, small reservoirs of which are held at points where the tendrils of the media cross, presenting a new and moist surface to which additional particles attach themselves. Any micro organisms caught on the moist surface of the filter are immediately rendered inert.

When a cell becomes dirty it is removed from the frame by handles provided for the purpose and washed in a solution of hot water and ordinary washing soda. After draining for a reasonable period it is again dipped in the adhesive fluid and replaced in the frame. Cleaning periods average from a month to six weeks, depending, of course, on local dust conditions.

RESULTS OF INSTALLATION

When the system had been installed we thoroughly cleaned and fumigated the buildings so as to remove any existing bacteria.



Expanded Metal Air Filter Unit Used in Nucoa Butter Company's Plant

Instructions were issued that all windows and doors would be kept shut so that all air in the buildings would be entirely supplied through the ventilating system and the air filters. The volume of air admitted into the rooms from the outside is such as to build up a positive pressure in the rooms which eliminate leakage or influx through windows or doors. The system was also designed to permit recirculation during the winter months, the amount of air to be recirculated being adjusted by a damper regulator; the returned air, however, being passed through the filter and recleaned. This recirculation results in a large saving in coal for heating purposes during the winter. Illustrations show the bank or filter units and the general layout of the fan system.

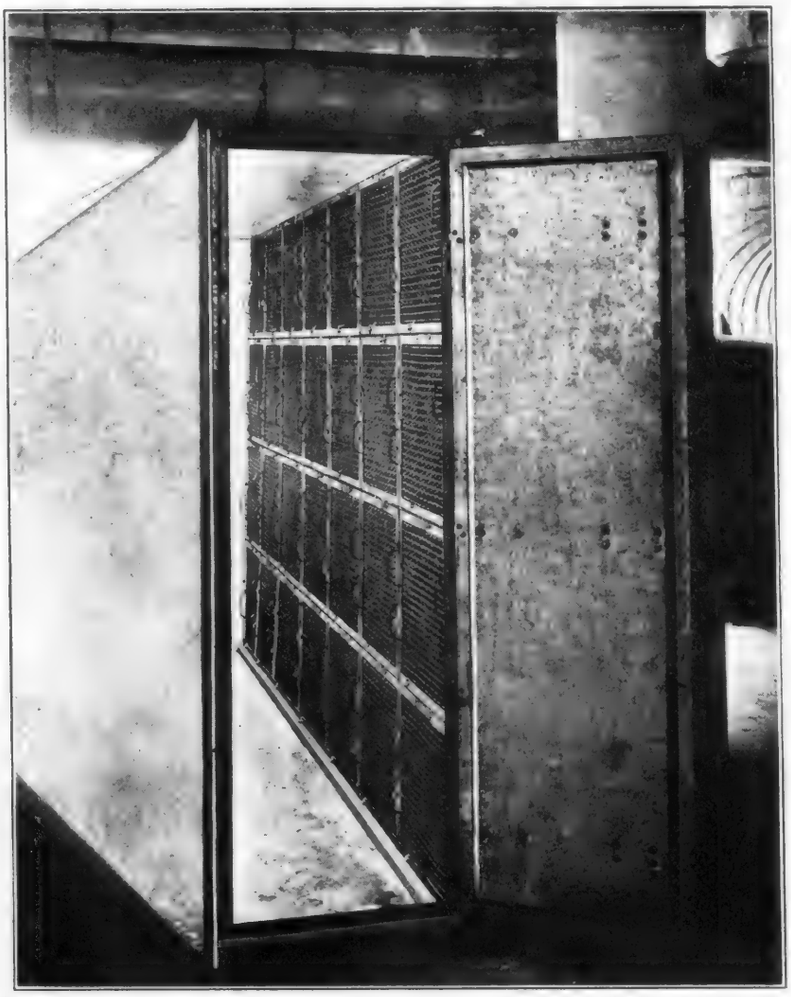
The company wished, as an additional safeguard, to keep the ducts clean during periods of shutdown so filter units were placed in each duct outlet which prevents the possible lodging of bacteria colonies in the ducts from back drafts. This feature is shown in the illustration.

The results from this installation exceeded all expectations. The report of our chief chemist states that before the system was installed the bacteriological tests showed an average of 144 colonies per plate. After the system had been in operation the tests showed 0.6 per plate, or a reduction of over 99½%.

COST

The cost of operation of the filters is comparatively low as there are no moving parts, and nothing to wear out; the only expense

Arrangement of Filter Units for Bacteria Removal, in Air Outlets. Plant of Nucoa Butter Company



Battery of Air Filter Units as Installed in Plant of Nucoa Butter Company

involved being a periodic cleaning of the filter units and the small amount of adhesive compound used to recharge the cells. The resistance of the filter is about ¼ in. water gauge when the cleaning of the cells is carried out as a routine operation.

New Publications

REPORT OF A SPECIAL INVESTIGATION, made by the H. P. Gould Company (Report No. 1) shows some remarkable economies effected through the use of Republic flow meters, made by the Republic Flow Meters Co., Chicago, Ill. The buildings in which the meters were installed are those of the Gair Realty Corporation, in Brooklyn, N. Y. One of these meters measures the total amount the tenants, and the remaining twelve meters measures the total amount of steam used by the tenants ,and the remaining twelve meters measure the steam delivered to each tenant, The purpose of the one large meter is to check the accuracy of the twelve individual instruments. Steam is purchased and distributed to the tenants. Detailed figures are given of operation before and after these meters were installed. The saving in labor and maintenance was found to be $1426.19 per year. In addition, the meters permitted a saving in the amount of steam consumed during the night of $2000.

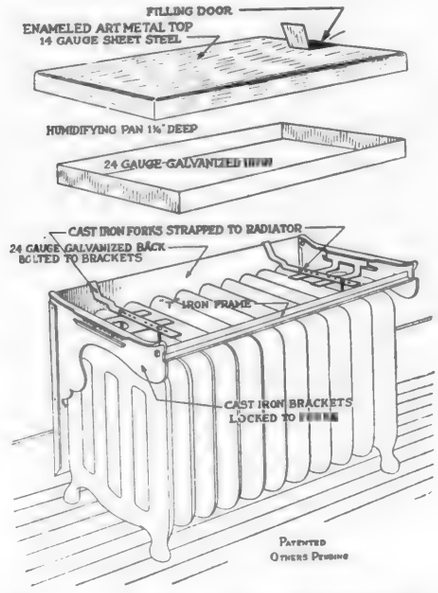
As is well known, it is difficult for an engineer to know just what amount of steam to pass through the heating coils to keep the building properly heated. Since the installation of these meters, charts have been obtained showing the number of pounds of steam required per hour to keep the buildings properly heated for each outdoor temperature. These charts are posted in the engine room and every two hours the night watchman reports the outside temperatures to the engineer who is guided accordingly, and adjusts his valves until the proper flow of steam is obtained. This system of check on the heating steam is believed to be responsible for about $2000 per year saved in the cost of heating.

BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for January 15, 1924, contains the tentative program for the forthcoming annual convention of the association in New York, June 10, 11 and 12, next. Headquarters will be at the Hotel Commodore. Among the interesting articles in this number is one on "An Automatic Steam De-Superheater," by A. D. Leach. "Corrosion in Central Station Heating Plants" is discussed by J. R. McDermet, of the Elliott Company; and "Insurance Engineering and Its Relation to District Heating" by S. Morgan Bushnell. H. F. Eddy contributes a further description of the new Grand Rapids central heating plant of the Consumer's Power Company, which he presented at the last meeting of the association in Cedar Point.

New Trade Publications

KIELEY STEAM, WATER AND AIR SPECIALTIES are covered in a general catalog issued by Kieley & Mueller, Inc., New York. The catalog is a voluminous one, consisting of more than 100 pages and containing detailed descriptions and views of many of the company's products. Among the products treated in the catalog are: reducing valves, for steam, gas, water and air; float valves, hot or cold water; pump governors and automatic control devices; strainers; condensation pump governors; high and low water-alarm columns; damper regulators; boiler water-feeders; hot-water temperature controllers; non-return stop and check valves; back-pressure valves; steam traps; oil and grease extractors; and priming devices. Size 11 x 8½ in. Pp. 102 and cover.

TRICO, THE HUMIDIFYING SHIELD, is brought to the attention of the trade in a new circular issued by the Art Metal Radiator Cover Co., Oakdale and Oakley Sts., Chicago, Ill., and showing the latest design of this humidifier. These devices which, as will be seen, are intended to be placed over



Arrangement of Trico Humidifying Shield

the radiator, are equipped with an evaporating surface the length and width of each radiator. In this way the room air is not only moistened but the dust in the rising air currents is caught by the shield. The shield also acts to deflect and moisten the heated air, delivering it more promptly to the lower part of the room.

BANNER ROCK WOOL JACKET, manufactured by the Banner Rock Products Co., Alexandria, Ind., is presented in Bulletin No. 14 recently issued. The product is a flexible insulation, made of selected rock wool, secured between metal fabrics and applicable to all contours. It is designed for insulation of furnaces of all kinds, boilers, ovens, tanks, tank cars, kilns or any other hot surface. The bulletin is attractively illustrated by sections of rock wool jacket and installation views.

Outlook Favorable

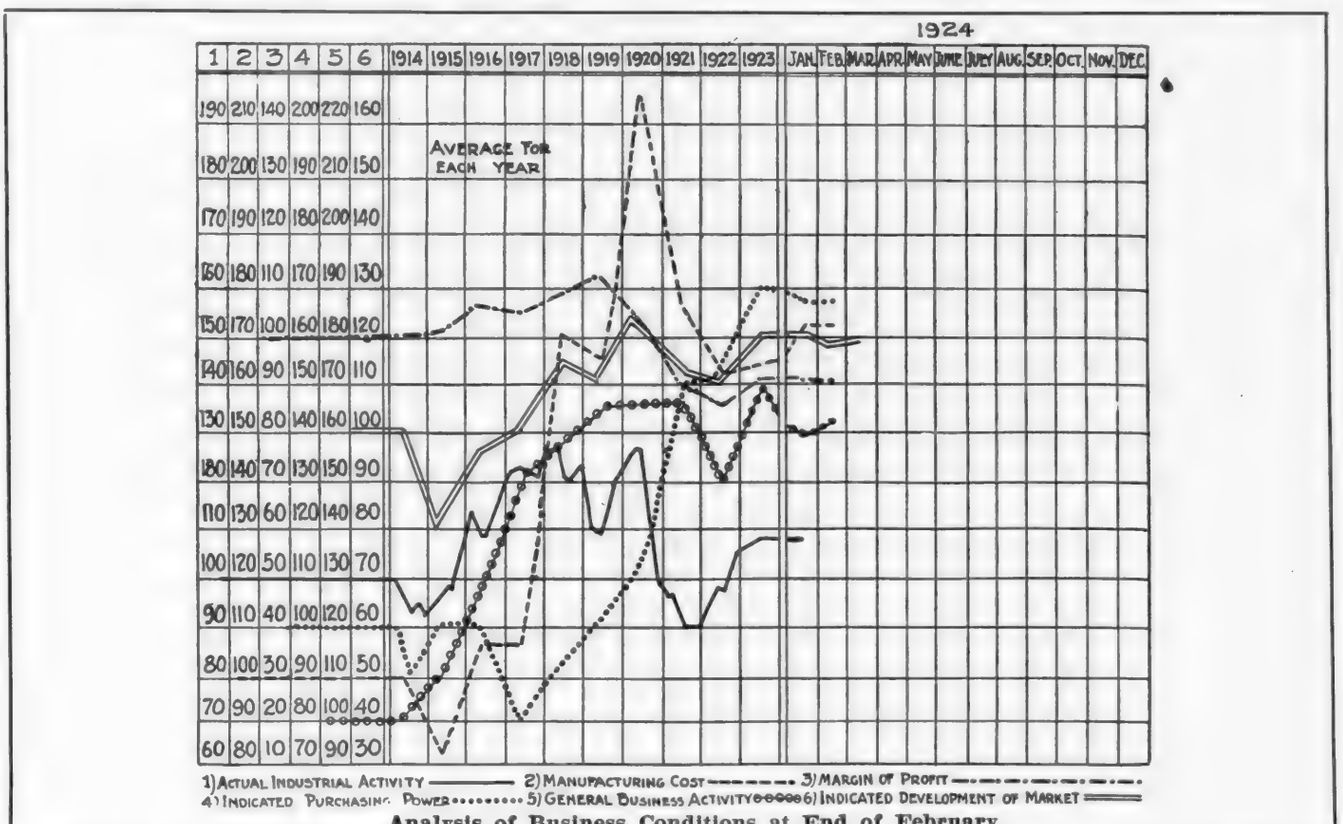
General Improvement Expected In Second Half of March. Need for Well Measured Supply of Quality Merchandise

Especially Prepared for THE HEATING AND VENTILATING MAGAZINE

By L. W. Alwyn-Schmidt

NEWS from all markets indicates a general return of confidence. Business although still freakish in spots, has improved noticeably and the outlook for the future appears bright. To appreciate the effect of the present situation upon the development of the market cognizance must be taken of the fact that tax payments are due in March. The theory of tax payments, of course, is that taxes are paid out of the income of the preceding year. In practice, however, taxes are paid from the current earnings and tax payments, therefore, reduce temporarily the able total of building and life insurance investment during 1923, seems to have spent its force, and the nation apparently is now settling down to a quiet enjoyment of its earnings. But while more money most likely will be available for everyday needs, there is increasing evidence of a return to the good American sentiment of "getting a dollar's worth for a dollar." The nation, after having bought its homes and motor cars, and having secured the future of its widows and orphans, looks around for goods to purchase which are worth their therefore, are brought to the notice of those interested in this subject.

The cost of life's necessities has not changed sufficiently to produce a serious drain upon the wage earner's income. Wages, on the other hand, have shown a small increase. The influence of this increase, however, upon the cumulative purchasing power of the nation is counteracted by a slight decrease in the employment ratio, leaving the situation as a whole where it was in January. This, consequently, is not a market calling for excess production in



Analysis of Business Conditions at End of February

volume of cash available for other expenditure. They provide, consequently, an unsettling factor. The chances are that tax payments will not effect appreciably the consumers' budget this year. Industry, however, might find the problem a more difficult one and the financing of tax payments doubtless retains much money in corporation treasuries at the present time which otherwise would be in circulation.

Such accumulation of funds will end automatically by March 15, and there is enough in February's reckoning which lets us expect reasonably good business during the second half of March and further improvement during April and the later part of Spring.

The wave of economy which has swept this country, rolling up an almost unbelievprice. Popular demand runs in the direction of quality merchandise of the sort that will repay the outlay by durability and dependability, and it is this class of goods which our manufacturers will have to turn out if they want to attract the consumer.

This tendency, which was noted during the Christmas business, has turned out to be the deciding factor during the February sales. It has forced a readjustment of prices for all consumer merchandise, leading to a strengthening of the price situation in all quality goods while producing a downward movement in the lower-grade articles.

In view of this situation industrial producers may have to reconsider their manufacturing policies for the Summer and Autumn business. The following facts, the hope that the goods will finally be taken up at the manufacturer's valuation. What we require is a well-measured but secure supply of quality merchandise which should be available at short notice. This can be effected by close co-operation between manufacturer and jobber, with the latter aiding the first by keeping a sufficient stock, so as not to create the need for forced production during limited periods.

If this balance of demand and supply can be established, we shall gain many advantages. We shall first secure for labor regular employment, carrying the seasonal industries easily over their so-called slow months. We shall encourage the wage earner and salaried man to spend their earnings as they go along because there will be no need to lay

by an additional reserve for the rainy day. We shall secure for the retailer a practically continuous run of reasonably good business. This, in turn, will bring to the jobber and manufacturer a further improvement in the credit situation.

All this can be attained by the very simple expedient of avoiding over-production. And with the realization of this situation leaders of industrial opinion in this country have turned down already the somewhat exuberant utterances with which they have heralded the new year. We need, of course, all the optimism we can muster. But we need just now more common sense and a common-sense estimation of the capacity of the market. Business is thoroughly healthy. It shows a marked improvement wherever improvement is most necessary to insure a continuation of its healthy development. Now it is up to everybody to turn this generally favorable situation in a direction where it may produce a new forward movement. The stage for this, no doubt, is set. Let us watch the actors so that they will do their part well.

Considering that we are going towards a presidential election, we are doing, in fact, wonderfully well. We are doing better than might have been reasonably expected. This is a good sign for the underlying strength of the market. The country apparently has learned to discount beforehand the economic unrest of the election. The times are past when presidential elections could seriously upset the economic balance of the American market.

New Clarage Air Washer

A new air washer for operation in public buildings and for industrial application has recently been placed upon the market by the Clarage Fan Co., Kalamazoo, Mich. It is shown in the accompanying illustrations. Special attention is directed by the manufacturer to the design of the spray nozzles which are considered one of the washer's most important features. The interior passages of the nozzle, sufficiently large to prevent clogging under all conditions, are designed to impart to the water a swirling motion as it leaves the outlet orifice, and to so diffuse the water that the spray measures 15 in. in diameter at a distance of 7½ in. from the tip of the nozzle. Each nozzle has a capacity for discharging 2 gal. of water per minute under the usual pump pressure of 20 lbs. The nozzles are spaced over the washing chamber in the ratio of three nozzles per 1000 cu. ft. of air per minute, permitting an unbroken spray to extend over an entire cross-section of the washer.

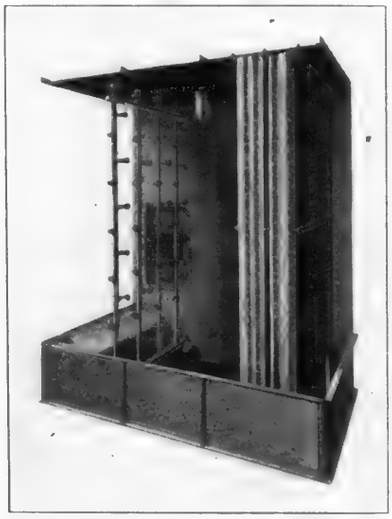


Fig. 1—Arrangement of Scrubber and Eliminator Plates in Clarage Air Washer

Fig. 1 shows the arrangement of the scrubber and eliminator plates, designed for removing the dust and other foreign matter, as well as any entrained moisture. The combined depth of the eliminator and scrubber plates is 12¾ in., while the total amount of washing surface provided equals 25.25 sq. ft. per 1,000 cu. ft. of air per minute. Detached lead spacers are used to simplify the erection of these plates, as compared with the method of springing or forcing the plates into long notched angles. To eliminate unnecessary strain on the side walls of the washer, the scrubber and eliminator sections are carried on a base support resting on the bottom of the tank.

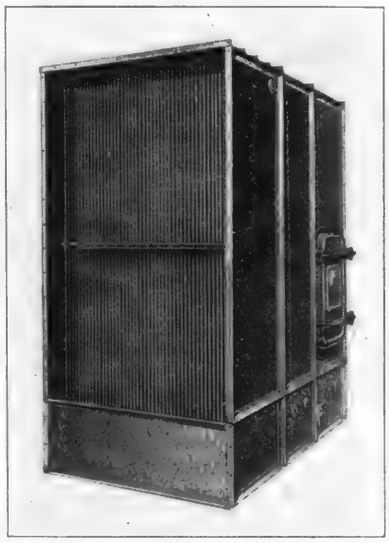


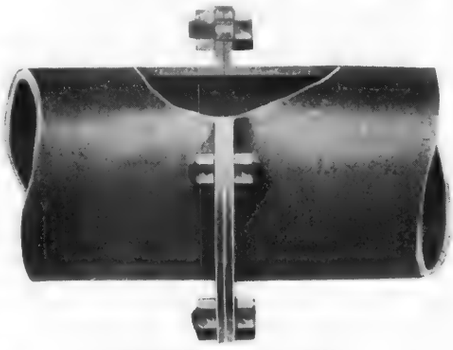
Fig. 2—Clarage Air Washer, Showing Water-Tight Inspection Door

The entire washer is 7 ft. long regardless of other dimensions, with a tank extending the full length and having a depth of 18 in. Flooding nozzles, not always necessary, are provided for certain types of work. A water-tight inspection door measuring 18 x 30 in., with a heavy glass window 12 in. square, shown in Fig. 2, is another detail of interest. It is held tight against the gasket by locking cams on all four corners. When the door is closed the handle is parallel to the side of the washer and the cams press the door against the gasket. Pulling this handle away from the washer lifts the cams out of their notches, so that they can be swung to the side and the door is free to open. With the exception of the supporting pins, the construction is the same at all four corners, and the door may be swung either way by moving the pins from one side to the other. An adjustment is provided for taking up the wear on the cams so that a tight fit may be maintained.

A catalog devoted to the Clarage Type "V" air washer is now ready for distribution by the manufacturer.

Lap Joints for Piping.

One of the exhibits at the recent New York Power Show was a Ballwood lap joint, shown in the accompanying illustration. This joint, it will be noticed, is an integral part of the pipe. The flange or lap, after ness as the wall of the pipe. Laps are



Ballwood Lap Joint

avoided with square corners so that the metal at the bend is somewhat thicker than the wall of the pipe. Bolt holes are drilled in the lap, of requisite diameter and number in proportion to the pipe itself. The joint is described as well adapted to low-pressure or exhaust lines and less expansive than a flanged joint, as well as cheaper to erect. The manufacturer is the Ballwood Co., 30

What Do You Get Out of It?, Who Qualifies, The Little Fellow and Dues, are the titles of four circulars published by the Heating and Piping Contractors' National Association, under the authorship of George M. Getschow, president and Henry B. Gombers, secretary. The pamphlets are written around the idea that association with other men in the same industry is the keynote which should be sounded in building up trade associations. For instance, in the pamphlet on "What Do You Get Out of It?, the author points out that "the by-products of exclusive usefulness that has come to our members from the association has been so great and of such immediate business value to them that it is not surprising they should, in answering that question, try to 'list up' the benefits of the inquirer. Yet the benefits one can thus 'list up'—great as may be their utility, are in fact by-products—and by no means principal products. Further on the Writers states: "Much—most, in fact—of the action that is taken by the national associations is of broad public value. Seemingly non members benefit equally with members; often the big public gets a full share. But who really wins? Isn't it the men who have done the work? No matter what the outcome, the discussions, the contacts men form in such conferences are valuable to them beyond measure. . . . There is no man, no matter how clever, who cannot gain by contact with other men; especially other men struggling with the same problems which beset him." The pamphlets betoken a spirit within the association which is now finding expression along the right lines.

When you specify heating equipment remember these good words:

IDEAL BOILERS
COAL · OIL · GAS
and AMERICAN RADIATORS
save fuel

AMERICAN RADIATOR COMPANY

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

One-Column Steam, Enclosed, Front and Top Registers

STEAM AT 215°F

1 COLUMN RADIATOR

REGISTERS 60% OPEN

ENCLOSED RATING FRONT AND TOP REGISTERS

SECTIONS	LENGTH IN INCHES	38"			32"			26"			23"			20"		
		Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	INLET 6"	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	INLET 6"	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	INLET 6"	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	INLET 6"	Actual Surface	Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	INLET 6"
2	5	6	5.9	6.3	5	5.1	5.4	4	4.2	4.5	3⅓	3.6	3.8	3	3.2	3.4
3	7½	9	8.0	8.6	7½	7.0	7.4	6	5.7	6.1	5	4.9	5.2	4½	4.4	4.7
4	10	12	10.1	10.8	10	8.7	9.3	8	7.2	7.7	6⅔	6.2	6.6	6	5.6	5.9
5	12½	15	12.2	13.0	12½	10.6	11.3	10	8.7	9.3	8⅓	7.4	7.9	7½	6.8	7.2
6	15	18	14.4	15.4	15	12.5	13.3	12	10.3	11.0	10	8.7	9.3	9	7.9	8.4
7	17½	21	16.5	17.6	17½	14.3	15.3	14	11.8	12.6	11⅔	9.1	10.6	10½	9.2	9.8
8	20	24	18.7	19.9	20	16.2	17.3	16	13.3	14.2	13⅓	11.3	12.1	12	10.3	10.1
9	22½	27	20.9	22.2	22½	18.1	19.3	18	14.9	15.8	15	12.7	13.5	13½	11.6	12.3
10	25	30	23.0	24.5	25	19.1	21.3	20	16.4	17.4	16⅔	13.1	14.9	15	12.7	13.5
11	27½	33	25.1	26.8	27½	21.8	23.2	22	17.9	19.0	18⅓	15.2	16.2	16½	13.9	14.8
12	30	36	27.3	29.1	30	23.6	25.2	24	18.8	20.1	20	16.5	17.6	18	14.5	15.4
13	32½	39	29.5	31.4	32½	25.5	27.2	26	20.9	22.3	21⅔	17.9	19.0	19½	16.3	17.4
14	35	42	31.5	33.6	35	27.4	29.2	28	22.4	23.9	23⅓	19.1	20.4	21	17.4	18.6
15	37½	45	33.8	36.0	37½	29.3	31.2	30	24.0	25.6	25	20.5	21.8	22½	18.6	19.8
16	40	48	35.9	38.2	40	31.1	33.1	32	25.5	27.2	26⅔	21.8	23.2	24	19.8	21.1
17	42½	51	37.9	40.4	42½	32.9	35.1	34	27.0	28.8	28⅓	23.0	24.6	25½	21.2	22.6
18	45	54	39.1	42.6	45	34.7	36.1	36	28.6	30.5	30	24.3	25.9	27	22.7	24.2
19	47½	57	42.2	45.0	47½	36.6	38.0	38	30.2	32.2	31⅔	25.7	27.4	28½	23.3	24.9
20	50	60	44.3	47.2	50	38.4	40.1	40	31.7	33.8	33⅓	26.9	28.6	30	24.5	26.1
21	52½	63	46.3	49.4	52½	40.1	42.8	42	33.1	35.3	35	28.1	30.0	31½	25.7	27.4
22	55	66	48.5	51.7	55	42.1	44.9	44	34.1	37.3	36⅔	29.5	31.4	33	26.1	28.6
23	57½	69	50.5	53.8	57½	43.8	46.7	46	36.2	38.6	38⅓	30.7	32.7	34½	27.1	29.8
24	60	72	52.5	56.0	60	45.7	48.7	48	38.0	40.6	40	32.0	34.2	36	29.1	31.0
25	62½	75	54.7	58.3	62½	47.4	50.6	50	39.2	41.8	41⅔	33.2	35.4	37½	30.4	32.4
26	65	78	56.9	60.6	65	49.3	52.6	52	40.7	43.4	43⅓	34.3	36.6	39	31.6	33.7
27	67½	81	59.0	62.1	67½	51.2	54.6	54	42.2	45.0	45	36.9	38.2	40½	32.6	34.8
28	70	84	60.1	65.0	70	52.9	56.4	56	44.0	46.1	46⅔	37.1	39.5	42	33.8	36.1
29	72½	87	62.9	67.0	72½	54.6	58.2	58	45.0	48.0	48⅓	38.3	40.8	43½	34.1	37.3
30	75	90	65.0	69.4	75	56.5	60.2	60	46.5	49.6	50	39.6	42.2	45	36.0	38.4
31	77½	93	66.9	71.4	77½	58.1	62.0	62	47.9	51.1	51⅔	40.7	43.4	46½	37.1	39.5
32	80	96	69.1	73.7	80	60.1	64.1	64	49.5	52.8	53⅓	42.1	44.9	48	38.3	40.8
33	82½	99	70.1	75.7	82½	61.5	65.6	66	50.9	54.2	55	43.2	46.1	49½	39.4	42.0
34	85	102	73.1	78.0	85	63.5	67.7	68	52.4	55.9	56⅔	44.5	47.4	51	40.5	43.2
35	87½	105	74.9	79.9	87½	65.1	69.4	70	53.7	57.3	58⅓	45.7	48.7	52½	41.3	44.0
36	90	108	77.0	82.2	90	66.9	71.4	72	55.3	58.1	60	46.1	50.1	54	42.8	45.6
37	92½	111	78.9	84.2	92½	68.6	73.1	74	56.6	60.0	61⅔	48.1	51.3	55½	43.1	46.9
38	95	114	81.0	86.4	95	70.4	75.0	76	58.1	62.0	63⅓	49.4	51.6	57	44.9	47.9
39	97½	117	83.0	88.4	97½	72.0	76.6	78	59.4	63.4	65	50.5	53.8	58½	46.1	49.2
40	100	120	84.9	90.6	100	73.6	78.6	80	60.9	64.1	66⅔	51.8	55.2	60	47.8	50.5

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RADIATOR RATINGS—1-COL. STEAM, ENCLOSED, FRONT AND TOP REGISTERS

No. 14-D

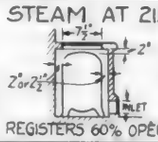
THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Two-Column Steam, Enclosed, Front and Top Registers

STEAM AT 215°F.

2 COLUMN RADIATOR



REGISTERS 60% OPEN

ENCLOSED RATING FRONT AND TOP REGISTERS

SECTIONS	LENGTH IN INCHES	45" Actual Surface	45" Equivalent surface at 250 btu per sq ft INLET 4"	45" Equivalent surface at 250 btu per sq ft INLET 6"	38" Actual Surface	38" Equivalent surface at 250 btu per sq ft INLET 4"	38" Equivalent surface at 250 btu per sq ft INLET 6"	32" Actual Surface	32" Equivalent surface at 250 btu per sq ft INLET 4"	32" Equivalent surface at 250 btu per sq ft INLET 6"	26" Actual Surface	26" Equivalent surface at 250 btu per sq ft INLET 4"	26" Equivalent surface at 250 btu per sq ft INLET 6"	23" Actual Surface	23" Equivalent surface at 250 btu per sq ft INLET 4"	23" Equivalent surface at 250 btu per sq ft INLET 6"	20" Actual Surface	20" Equivalent surface at 250 btu per sq ft INLET 4"	20" Equivalent surface at 250 btu per sq ft INLET 6"
2	5	10	9.5	10.1	8	7.4	7.9	6⅔	6.0	6.4	5⅓	5.1	5.4	4⅔	4.7	4.1	4	3.1	4.2
3	7½	15	13.0	13.9	12	10.1	9.7	10	8.6	9.2	8	6.9	7.4	7	6.3	6.7	6	5.6	5.9
4	10	20	16.4	17.4	16	12.6	13.4	13⅓	10.8	11.6	10⅔	9.1	9.7	9⅓	7.1	8.5	8	6.1	7.4
5	12½	25	19.7	20.9	20	15.2	16.2	16⅔	13.2	15.1	13⅓	10.9	11.6	11⅔	10.4	11.1	10	8.4	8.9
6	15	30	23.6	25.1	24	18.0	19.2	20	15.5	16.5	16	12.9	12.8	14	11.4	12.2	12	9.9	10.6
7	17½	35	26.9	28.3	28	20.8	22.2	23⅓	17.8	18.1	18⅔	14.9	15.8	16⅓	13.1	13.9	14	11.4	12.2
8	20	40	30.4	32.3	32	23.4	24.1	26⅔	20.2	21.5	21⅓	16.7	17.8	18⅔	14.8	15.8	16	12.9	13.8
9	22½	45	33.9	36.0	36	26.0	27.8	30	22.5	24.2	24	18.5	19.7	21	16.5	17.6	18	14.4	15.4
10	25	50	37.4	39.8	40	28.8	30.7	33⅓	24.8	26.4	26⅔	20.5	21.8	23⅓	18.2	19.4	20	15.9	16.1
11	27½	55	40.9	43.8	44	31.4	33.5	36⅔	27.1	28.9	29⅓	22.2	23.7	26⅔	19.9	21.2	22	17.3	18.5
12	30	60	44.3	47.1	48	34.2	36.5	40	29.3	31.2	32	24.1	25.7	28	21.5	22.1	24	18.9	20.2
13	32½	65	47.9	50.9	52	36.8	39.3	43⅓	31.6	33.7	34⅔	25.9	27.6	30⅓	23.1	24.6	26	20.3	21.6
14	35	70	51.4	54.6	56	39.5	42.1	46⅔	33.9	36.2	37⅓	27.8	29.6	32⅔	24.8	26.5	28	21.8	23.2
15	37½	75	54.7	58.1	60	42.2	44.1	50	36.2	38.6	40	29.7	31.6	35	26.5	28.2	30	23.3	24.6
16	40	80	58.2	61.8	64	44.7	47.7	53⅓	38.4	40.1	42⅔	31.5	33.6	37⅓	28.1	30.0	32	24.8	26.4
17	42½	85	61.6	63.5	68	47.3	50.5	56⅔	40.7	43.4	45⅓	33.3	36.5	39⅔	29.8	31.8	34	26.1	27.8
18	45	90	65.0	69.1	72	50.2	53.4	60	43.1	45.9	48	35.3	37.6	42	31.5	33.6	36	27.6	29.4
19	47½	95	68.5	72.8	76	52.8	56.3	63⅓	45.2	48.2	50⅔	36.1	39.4	44⅓	33.1	35.3	38	29.1	31.0
20	50	100	71.7	76.2	80	55.1	58.8	66⅔	47.4	50.6	53⅓	38.9	41.5	46⅔	34.8	37.1	40	30.5	32.5
21	52½	105	75.3	79.1	84	57.9	61.8	70	49.8	53.1	56	40.7	43.4	49	36.5	38.9	42	32.0	34.2
22	55	110	78.6	83.5	88	60.5	64.5	73⅓	51.9	55.4	58⅔	42.7	45.5	51⅓	38.2	40.7	44	33.4	35.6
23	57½	115	82.2	87.4	92	63.2	67.5	76⅔	54.4	58.0	61⅓	44.6	47.5	53⅔	39.8	42.4	46	34.9	37.2
24	60	120	85.4	90.7	96	65.6	70.0	80	56.5	60.2	64	46.4	49.4	56	41.3	44.1	48	36.3	38.7
25	62½	125	88.8	93.5	100	68.5	73.0	83⅓	58.7	62.6	66⅔	48.2	51.4	58⅓	42.1	45.8	50	37.8	40.3
26	65	130	92.0	97.8	104	70.9	75.6	86⅔	60.8	64.8	69⅓	50.3	53.6	60⅔	43.2	48.2	52	39.1	41.9
27	67½	135	95.7	101.2	108	73.5	78.4	90	63.2	67.4	72	51.8	55.2	63	46.4	49.5	54	40.7	43.4
28	70	140	98.5	104.6	112	75.8	80.9	93⅓	65.2	69.5	74⅔	53.9	57.4	65⅓	47.9	51.1	56	42.2	44.1
29	72½	145	102.1	108.5	116	78.7	83.1	96⅔	67.7	72.2	77⅓	55.5	59.2	67⅔	49.5	52.8	58	43.5	46.4
30	75	150	105.3	109.9	120	81.0	86.4	100	69.6	74.2	80	57.2	61.0	70	51.1	54.5	60	44.9	47.9
31	77½	155	108.5	115.3	124	83.3	88.9	103⅓	71.9	76.7	82⅔	58.7	61.6	72⅓	52.5	56.0	62	46.1	49.1
32	80	160	111.2	118.2	128	86.0	91.8	106⅔	73.9	78.8	85⅓	60.8	64.8	74⅔	54.2	57.8	64	47.5	50.6
33	82½	165	114.6	121.7	132	88.9	94.2	110	75.8	80.9	88	62.3	66.5	77	56.7	59.4	66	48.9	52.2
34	85	170	118.0	125.4	136	90.9	96.1	113⅓	78.2	83.4	90⅔	63.1	68.2	79⅓	57.3	61.1	68	50.4	53.8
35	87½	175	120.1	128.5	140	93.2	99.4	116⅔	80.3	85.6	93⅓	65.9	70.2	81⅔	58.7	62.6	70	51.7	55.1
36	90	180	124.6	132.3	144	95.9	102.3	120	82.5	88.0	96	67.7	77.2	84	60.5	64.5	72	53.1	56.6
37	92½	185	127.9	135.9	148	96.4	104.1	123⅓	84.8	90.4	98⅔	69.6	74.2	86⅓	62.2	66.3	74	54.6	58.2
38	95	190	130.6	138.8	152	100.7	107.4	126⅔	86.6	92.4	101⅓	71.4	76.2	88⅔	63.7	67.9	76	55.1	59.7
39	97½	195	134.2	143.6	156	103.5	110.4	130	88.1	94.9	104	73.1	77.9	91	65.3	69.6	78	57.3	61.1
40	100	200	137.6	145.2	160	105.2	113.3	133⅓	91.2	97.3	106⅔	75.0	80.0	93⅓	66.9	71.4	80	58.7	62.6

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RADIATOR RATINGS—2-COL. STEAM, ENCLOSED, FRONT AND TOP REGISTERS — No. 14-E

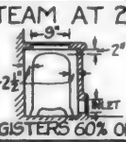
THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Three-Column Steam, Enclosed, Front and Top Registers

STEAM AT 215°F.

3 COLUMN RADIATOR



ENCLOSED RATING FRONT AND TOP REGISTERS

REGISTERS 60% OPEN

SECTIONS	LENGTH IN INCHES	45" Actual Surface	45" Equivalent surface at 250 btu. per sq. ft. INLET 4"	45" INLET 6"	38" Actual Surface	38" Equivalent surface at 250 btu. per sq. ft. INLET 4"	38" INLET 6"	32" Actual Surface	32" Equivalent surface at 250 btu. per sq. ft. INLET 4"	32" INLET 6"	26" Actual Surface	26" Equivalent surface at 250 btu per sq. ft. INLET 4"	26" INLET 6"	22" Actual Surface	22" Equivalent surface at 250 btu per sq. ft. INLET 4"	22" INLET 6"	18" Actual Surface	18" Equivalent surface at 250 btu per sq. ft. INLET 4"	18" INLET 6"
2	5	12	9.9	10.6	10	8.5	9.1	9	8.0	8.6	7½	6.9	7.1	6	5.7	5.9	4½	4.3	4.4
3	7½	18	13.6	14.5	15	11.7	12.9	13½	10.9	11.7	11¼	9.4	9.7	9	7.7	7.1	6¾	5.8	5.1
4	10	24	17.1	18.2	20	14.7	15.7	18	16.2	17.3	15	11.8	12.2	12	9.8	10.1	9	7.6	7.8
5	12½	30	20.7	22.1	25	17.8	18.9	22½	16.6	17.7	18¾	14.3	14.8	15	11.9	12.2	11¼	9.1	8.0
6	15	36	24.3	25.9	30	21.1	22.5	27	19.4	20.7	22½	16.9	17.4	18	13.9	14.3	13½	10.9	9.5
7	17½	42	27.9	29.8	35	24.1	25.7	31½	22.4	23.9	26¼	19.3	19.9	21	16.0	16.6	15¾	12.4	12.8
8	20	48	31.7	33.8	40	27.6	29.4	36	23.3	27.0	30	22.1	22.8	24	18.0	18.6	18	14.0	14.5
9	22½	54	35.7	38.0	45	30.7	32.7	40½	28.6	30.5	33¾	24.3	25.1	27	20.3	20.9	20¼	15.5	16.0
10	25	60	39.1	41.8	50	33.8	36.0	45	31.3	33.4	37½	27.0	27.9	30	22.3	23.0	22½	17.2	17.7
11	27½	66	42.6	43.4	55	37.1	39.6	49½	34.1	36.4	41¼	29.4	30.4	33	24.2	25.0	24¾	18.7	19.3
12	30	72	46.5	49.5	60	40.2	42.9	54	37.2	39.7	45	32.0	33.1	36	26.5	27.4	27	20.3	21.0
13	32½	78	50.4	53.7	65	43.3	46.2	58½	40.3	42.9	48¾	34.0	35.5	39	28.0	28.1	29¼	21.1	22.7
14	35	84	54.2	57.8	70	46.7	49.8	63	42.1	45.8	52½	37.1	38.3	42	30.5	31.5	31½	23.6	24.0
15	37½	90	57.4	61.2	75	49.5	52.8	67½	46.1	49.1	56¼	39.7	40.8	45	32.8	33.9	33¾	25.1	25.1
16	40	96	61.2	65.3	80	52.8	56.3	72	49.1	52.4	60	42.3	43.7	48	34.6	35.7	36	26.8	27.6
17	42½	102	65.1	69.4	85	56.2	59.9	76½	52.2	55.7	63¾	44.9	46.4	51	36.8	37.1	38¼	28.4	29.3
18	45	108	68.1	72.6	90	59.4	63.3	81	54.5	58.1	67½	47.1	48.7	54	38.9	40.1	40½	30.0	31.0
19	47½	114	71.9	76.6	95	61.9	66.1	85½	57.7	61.6	71¼	49.7	51.4	57	41.0	42.4	42¾	31.5	32.9
20	50	120	75.1	80.1	100	65.2	69.6	90	60.7	64.8	75	52.3	53.8	60	43.2	44.6	45	33.3	34.4
21	52½	126	79.4	84.6	105	68.5	73.0	94½	63.1	67.3	78¾	54.4	56.2	63	44.9	46.4	47¼	34.8	35.1
22	55	132	83.1	88.6	110	71.8	76.5	99	66.1	70.5	82½	56.9	58.9	66	47.3	48.9	49½	36.4	37.6
23	57½	138	86.1	92.7	115	75.1	80.1	103½	69.1	73.7	86¼	59.5	61.5	69	49.6	51.2	51¾	38.0	38.3
24	60	144	89.7	95.7	120	77.4	82.5	108	72.1	76.9	90	62.1	64.2	72	51.3	53.0	54	39.6	40.9
25	62½	150	93.4	99.6	125	80.6	86.0	112½	75.1	80.1	93¾	64.7	66.9	75	53.5	55.3	56¼	40.6	41.9
26	65	156	97.1	103.5	130	83.8	89.4	117	78.1	83.3	97½	66.1	69.3	78	55.6	57.4	58½	42.1	42.2
27	67½	162	100.8	107.5	135	87.1	92.9	121½	80.2	85.5	101¼	69.1	71.5	81	57.1	58.1	60¾	44.2	45.7
28	70	168	103.3	110.2	140	90.3	96.3	126	82.7	88.2	105	71.6	74.0	84	59.3	60.2	63	45.7	47.3
29	72½	174	106.9	114.1	145	93.5	99.7	130½	86.2	91.9	108¾	74.2	76.7	87	61.4	63.4	65¼	47.4	49.7
30	75	180	110.7	118.1	150	95.6	102.0	135	88.1	95.0	112½	76.7	79.3	90	63.5	65.6	67½	48.8	50.5
31	77½	186	113.6	121.2	155	98.8	105.2	139½	92.1	98.2	116¼	79.3	81.1	93	65.6	67.7	69¾	50.7	51.9
32	80	192	118.1	125.9	160	102.0	108.8	144	95.0	101.3	120	81.9	84.6	96	67.7	68.9	72	51.7	53.5
33	82½	198	121.7	129.8	165	105.1	112.2	148½	98.9	103.3	123¾	84.4	87.3	99	69.1	71.4	74¼	53.5	55.3
34	85	204	125.4	133.8	170	108.4	115.6	153	99.8	106.5	127½	87.0	90.0	102	71.2	73.5	76½	54.1	56.8
35	87½	210	127.6	136.1	175	110.2	117.6	157½	102.9	109.7	131¼	89.2	92.7	105	73.3	76.0	78¾	56.3	58.2
36	90	216	131.2	139.9	180	119.4	120.9	162	105.7	112.8	135	92.2	95.3	108	75.3	77.8	81	58.3	60.2
37	92½	222	134.9	143.8	185	116.5	124.3	166½	108.4	115.6	138¾	93.8	96.1	111	77.4	80.0	83¼	59.9	61.9
38	95	228	138.5	147.7	190	119.7	127.7	171	111.2	118.6	142½	96.0	99.2	114	79.3	82.0	85½	61.1	63.2
39	97½	234	142.1	151.6	195	122.8	131.0	175½	115.4	123.1	146¼	98.3	101.6	117	80.9	83.5	87¾	62.5	64.5
40	100	240	146.3	156.0	200	126.0	134.4	180	116.7	124.5	150	100.5	103.9	120	82.8	85.6	90	64.3	66.5

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RADIATOR RATINGS—3-COL. STEAM, ENCLOSED, FRONT AND TOP REGISTERS — No. 14-F

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Four-Column Steam, Enclosed, Front and Top Registers

STEAM AT 215° F

4 COLUMN RADIATOR

REGISTERS 60% OPEN

ENCLOSED RATING FRONT AND TOP REGISTERS

SECTIONS	LENGTH IN INCHES	45" Actual Surface	45" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	45" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"	38" Actual Surface	38" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	38" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"	32" Actual Surface	32" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	32" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"	26" Actual Surface	26" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	26" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"	22" Actual Surface	22" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	22" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"	18" Actual Surface	18" Equivalent surface at 250 b.t.u. per sq. ft. INLET 4"	18" Equivalent surface at 250 b.t.u. per sq. ft. INLET 6"
2	6	20	15.8	16.8	16	12.9	13.8	13	10.9	11.6	10	8.6	9.8	8	7.1	7.4	6	5.5	5.7
3	9	30	21.5	22.9	24	17.5	18.6	19½	14.7	15.7	15	11.7	12.1	12	9.7	9.1	9	7.4	7.2
4	12	40	27.0	28.8	32	21.1	23.5	26	18.6	19.8	20	14.8	15.3	16	12.2	12.6	12	9.4	9.7
5	15	50	32.6	34.8	40	26.6	28.4	32½	22.4	23.9	25	17.9	18.4	20	14.8	15.3	15	11.3	11.7
6	18	60	38.4	40.1	48	31.7	33.8	39	26.4	28.2	30	21.1	21.8	24	17.3	17.9	18	13.4	13.7
7	21	70	44.3	47.3	56	36.2	38.6	45½	30.5	32.5	35	24.2	25.0	28	20.1	20.8	21	15.4	15.9
8	24	80	50.2	53.5	64	41.1	43.8	52	34.4	36.7	40	27.5	28.4	32	22.7	23.4	24	17.4	18.0
9	27	90	55.1	59.7	72	45.8	48.8	58½	38.5	41.0	45	30.6	31.6	36	25.3	26.1	27	19.4	20.1
10	30	100	61.5	65.6	80	50.5	53.8	65	42.2	45.0	50	33.7	34.8	40	27.8	28.7	30	21.5	22.2
11	33	110	67.4	71.9	88	55.4	59.0	71½	46.3	49.4	55	36.1	38.3	44	30.4	31.4	33	23.5	24.5
12	36	120	73.1	77.9	96	60.2	64.2	78	50.3	53.6	60	39.2	41.5	48	33.0	34.1	36	25.5	26.4
13	39	130	78.7	83.9	104	64.4	68.7	84½	54.3	57.8	65	43.2	44.6	52	35.6	36.8	39	27.5	28.4
14	42	140	84.9	90.6	112	69.5	74.1	91	58.5	62.4	70	46.5	48.1	56	38.3	39.5	42	29.6	30.6
15	45	150	90.4	96.4	120	74.0	78.1	97½	62.3	66.4	75	49.7	51.3	60	40.8	42.2	45	31.7	32.7
16	48	160	96.0	102.4	128	78.8	84.0	104	66.2	70.6	80	52.9	54.6	64	43.3	44.7	48	33.5	34.6
17	51	170	102.1	108.8	136	83.5	89.0	110½	70.3	74.1	85	56.0	57.9	68	45.1	47.5	51	35.7	36.9
18	54	180	107.4	114.6	144	88.1	94.0	117	71.1	78.9	90	59.3	61.2	72	48.6	50.2	54	37.5	37.8
19	57	190	112.1	120.5	152	92.5	98.6	123½	77.6	82.8	95	62.3	64.3	76	51.2	52.9	57	39.4	40.7
20	60	200	118.9	126.8	160	97.7	104.2	130	81.9	87.4	100	65.4	67.6	80	53.8	55.6	60	41.4	42.8
21	63	210	123.9	132.2	168	101.6	108.3	136½	85.7	91.4	105	68.3	70.5	84	56.4	58.3	63	43.5	44.1
22	66	220	130.1	138.7	176	106.6	113.7	143	88.9	95.8	110	71.4	73.8	88	59.0	60.1	66	45.5	47.0
23	69	230	135.8	144.9	184	111.5	118.1	144½	93.9	100.2	115	74.9	77.3	92	61.7	63.7	69	47.6	49.1
24	72	240	141.1	150.5	192	115.7	123.4	156	97.5	104.0	120	77.6	80.2	96	63.7	65.8	72	49.8	51.2
25	75	250	143.4	156.8	200	120.5	128.6	162½	101.4	108.2	125	80.7	83.4	100	66.5	68.7	75	51.7	53.4
26	78	260	152.3	162.4	208	125.5	133.8	169	105.8	112.8	130	84.0	86.8	104	69.2	71.5	78	53.6	55.4
27	81	270	157.9	168.4	216	129.3	137.9	175½	108.1	116.2	135	87.2	90.1	108	71.3	73.7	81	55.5	57.4
28	84	280	162.1	173.8	224	134.3	143.2	182	112.5	120.0	140	90.0	93.0	112	73.9	76.3	84	57.8	58.1
29	87	290	168.8	180.0	232	138.2	147.4	188½	116.1	123.8	145	93.2	95.9	116	76.5	79.1	87	59.2	61.1
30	90	300	173.9	185.4	240	142.5	152.0	195	119.9	127.9	150	96.0	99.2	120	78.1	81.6	90	60.9	62.9
31	93	310	179.5	191.4	248	147.5	157.4	201½	123.5	131.8	155	100.5	103.9	124	81.5	84.2	93	62.9	65.0
32	96	320	185.3	197.6	256	152.0	162.2	208	128.3	136.8	160	102.4	105.8	128	84.4	87.2	96	64.9	67.0
33	99	330	189.1	202.6	264	156.0	166.4	214½	131.6	140.4	165	105.0	108.5	132	86.3	89.2	99	66.8	68.1
34	102	340	197.0	208.0	272	159.9	171.6	221	135.0	144.0	170	108.0	111.6	136	88.1	91.9	102	68.8	71.1
35	105	350	200.3	213.6	280	164.6	175.6	227½	138.8	148.0	175	110.4	114.1	140	90.9	93.9	105	70.7	73.0
36	108	360	206.3	220.0	288	169.4	180.7	234	143.7	152.8	180	113.4	117.2	144	93.5	96.6	108	72.8	75.2
37	111	370	217.3	226.4	296	174.0	185.6	240½	146.6	156.4	185	117.0	120.9	148	95.6	98.8	111	73.5	76.1
38	114	380	216.8	231.2	304	177.6	189.6	247	149.3	159.2	190	119.4	123.4	152	98.0	101.3	114	75.8	78.4
39	117	390	223.0	236.5	312	182.9	195.0	253½	153.6	163.0	195	122.6	126.7	156	100.5	103.9	117	78.0	80.6
40	120	400	226.9	242.9	320	186.2	198.6	260	156.9	166.4	200	126.0	130.7	160	103.1	106.6	120	79.9	82.5

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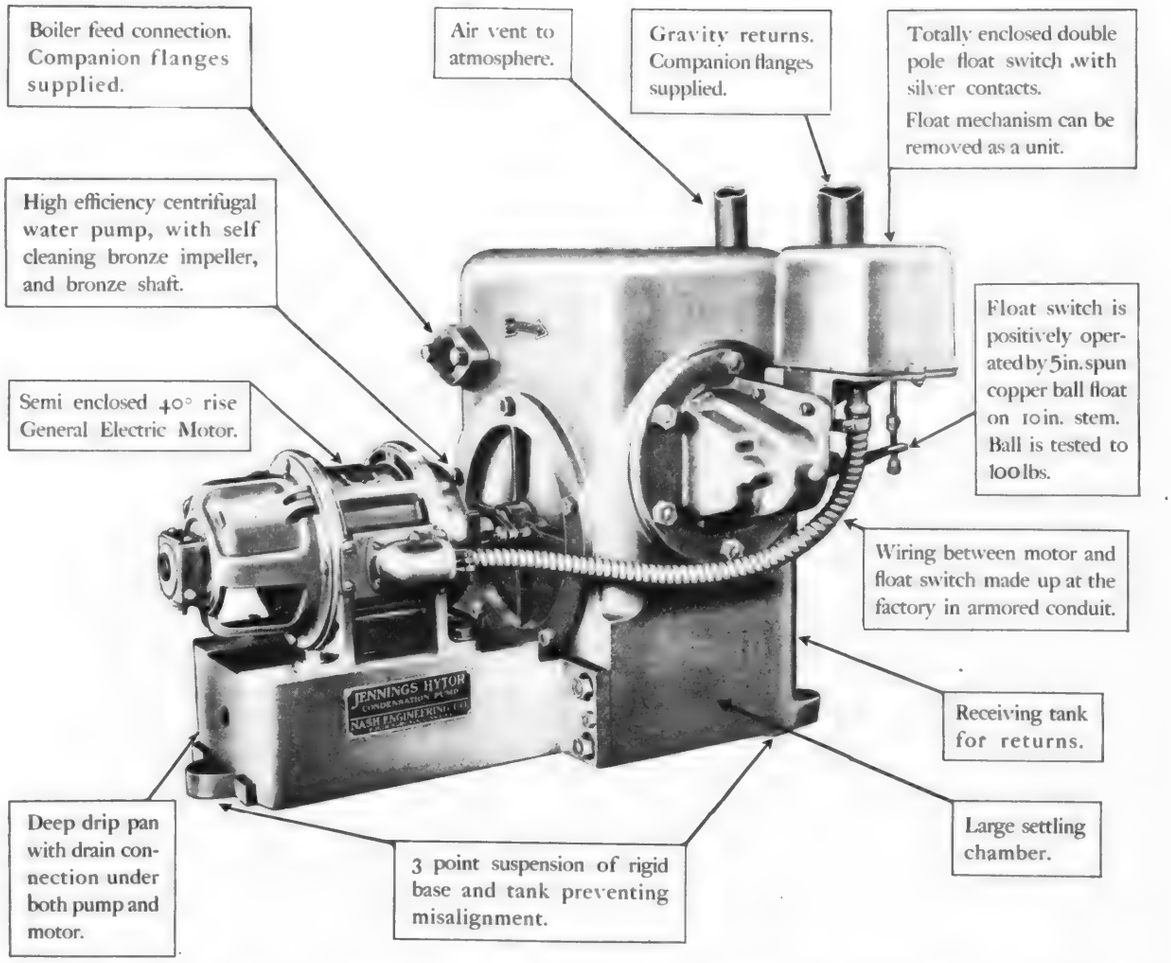
THE NEW UNIT TYPE JENNINGS HYTOR CONDENSATION PUMPS


Boiler feed connection. Companion flanges supplied.
Air vent to atmosphere.
Gravity returns. Companion flanges supplied.
Totally enclosed double pole float switch with silver contacts.
Float mechanism can be removed as a unit.
High efficiency centrifugal water pump, with self cleaning bronze impeller, and bronze shaft.
Float switch is positively operated by 5in. spun copper ball float on 10in. stem. Ball is tested to 100lbs.
Semi enclosed 40° rise General Electric Motor.
Wiring between motor and float switch made up at the factory in armored conduit.
Receiving tank for returns.
Deep drip pan with drain connection under both pump and motor.
3 point suspension of rigid base and tank preventing misalignment.
Large settling chamber.
JENNINGS HYTOR
CONDENSATION PUMP
NASH ENGINEERING CO.

The illustration shows construction of the Jennings Condensation Pump Unit. By making the pump casing a part of the receiving tank and bolting to the tank the base supporting the motor, allowing the motor bearings to support the bronze impeller, great structural strength is secured. The three point support prevents the pump from being sprung ont of line.

Large motor bearings supplied with ample oil wells support the pump impeller and keep it in alignment. Only occasional lubrication is necessary. The impeller is open type, self-cleaning, and very efficient.

The float switch mechanism is liberally proportioned, equipped with bronze shaft supported by two bearings.

The special G. E. double-pole float switch is totally enclosed and provided with silver contacts for long life. Switch mechanism can be removed as a unit.

The finest materials and best workmanship used in construction throughout, and all parts are machined to such close limits that absolute interchangeability is secured.

For Detailed Description Ask for Bulletin No. 29

NASH ENGINEERING CO.

SO. NORWALK CONN., U. S. .A

NASH ENGINEERING CO., South Norwalk, Conn., U. S. A.
Please send graphic device also bulletins covering
[ ] Hytor Air Compressors [ ] Return Line Heating
[ ] Hytor Vacuum Pumps [ ] Condensation Pumps
Name.....
Company.....
Position.....
Jan.

Trade and Miscellaneous Notes

Miscellaneous Notes

San Francisco, Calif.—A city-wide school reconstruction program to cost approximately $12,000,000 has been approved by the board of education of San Francisco, Calif. Funds were provided through a bond issue recently adopted by the voters.

Chemical Exposition, to be held in the Grand Central Palace New York City, September 28 to October 3, 1924, announces that many manufacturers who established exhibitions at the 1923 show have already engaged space for the 1924 exposition.

National Safety Council, with headquarters in Chicago, Ill., held a midyear safety conference at the Morrison Hotel, Chicago, February 19, when numerous manufacturers interested in the development and promotion of safety methods exchanged ideas and plans. The forenoon session was given over largely to a discussion of woodworking hazards, while the afternoon meeting considered especially health medical service.

New York.—American Society of Safety Engineers and the Engineering Section of the National Safety Council have merged under the name of the American Society of Safety Engineers, the Engineering Section of the National Safety Council. Announcement to this effect was made at a recent meeting in New York City.

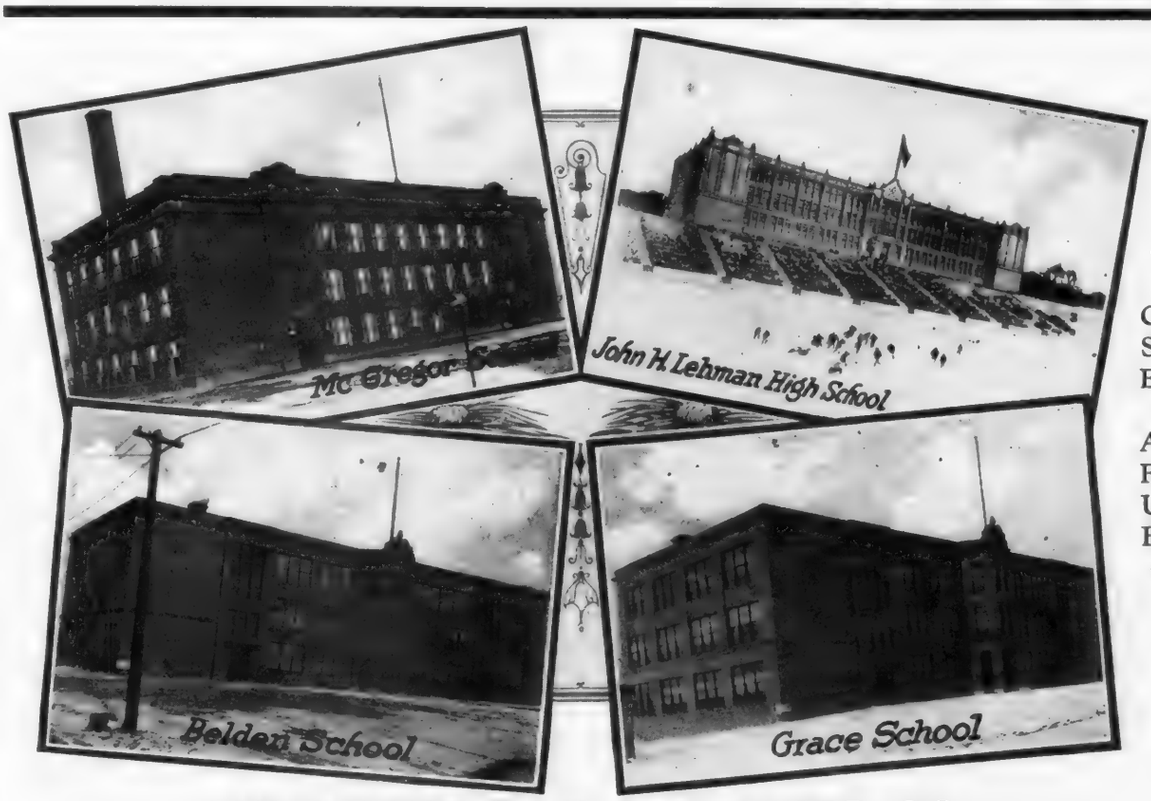
S. Itow, of Darien, Manchuria, has left for England after a visit of several months in the United States, studying American methods of heating and ventilating. Before returning to Japan to introduce American methods he will tour Europe to investigate European heating methods. Mr. Itow attended the recent annual meeting of the A. S. H. & V. E.

Better Mailing Week was observed February 18 to 25, under the direction of the Post Office Department which stressed the economic waste which annually results from careless addressing of letters and packages. The postal department has estimated that 200,000,000 pieces of mail annually are given "directory service"—that is postal employees take the time to provide, if possible, correct addresses for misdirected mail. In New York City alone the cost of this service is placed at $500 daily. The department urged especially that manufacturers check frequently their mailing lists to eliminate obsolete names and addresses.

Analysis of building operations during 1923, made by G. L. Miller & Co., New York, discloses that small Southern cities are growing more rapidly than cities of the same size in other parts of the country. The large cities, however, of the North and West, expended larger amounts per capita in 1923 for building than did the large cities of the South. Los Angeles, Calif., the analysis showed, expended $346 per capita, St. Paul $153, New York $137 and Atlanta, Ga., $135. Among the small cities St. Petersburg, Fla., led with an expenditure of $500 per capita.

Tacoma, Wash.—Tacoma's first "Own-Your-Home" Exposition will be held in Tacoma April 7-12, 1924. The heating and ventilating exhibit committee is headed by A. R. Chastain. At the first organization meeting over 40% of the available exhibition space was taken. Commenting upon the general idea of "Own-Your-Home" expositions, E. C. Hole, manager of the *American Lumberman*, Chicago, writes: "We believe this co-operative effort could be worked to advantage in a great many cities and towns throughout the United States. It certainly is a worth-while idea to endeavor to enlist people to think about owning their own homes."

Boston, Mass.—William J. Carlin, a well-known heating and ventilating engineer of Boston, has been appointed a member of the Boston Finance Commission by Governor Cox of Massachusetts. Mr. Carlin is treasurer of the Coffin Valve Company.



FOUR CANTON, O. SCHOOLS EQUIPPED WITH 24 AUTOVENT FANS AND UNIBLADE BLOWERS

AUTOVENT FAN & BLOWER CO.

Dept. "H."

730-738 W. MONROE ST. CHICAGO

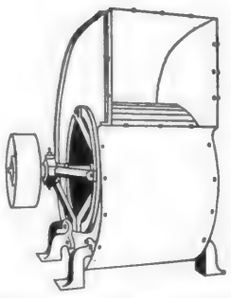
Heating and Piping Contractors' Boston Association elected the following officers at its annual meeting, which was held at Young's Hotel: President, H. A. Snow, treasurer of Buerkel & Co.; vice-president, M. E. Chase, of Morris & Chase; treasurer, W. T. Smallman, of the Isaac Coffin Co.; clerk, C. W. Sisson. Directors: F. S. Cleghorn, of the Cleghorn Co.; F. W. Howard, of Ingalls & Kendricken; P. A. Dolan, of P. A. Dolan & Co.; Thomas O'Callaghan, of the Acme Heating Co.; I. D. McLean, of the McLean & Cousens Co.; and T. A. Ridder, of the T. A. Ridder Co. At the dinner preceding the election, the retiring president, Ralph S. Franklin, was presented with a testimonial in the form of a chime clock as an appreciation of his services as president for the past two years. Former President F. A. Merrill made the presentation.

P. H. Seward, vice-president of the Richmond Radiator Co., New York, was the principal speaker at the February meeting of the Association of Plumbing and Heating Salesmen of Newark, N. J. His address was devoted to the past, present and future conditions from the manufacturer's viewpoint. He predicted a continuance of the present prosperous conditions for the next two years.

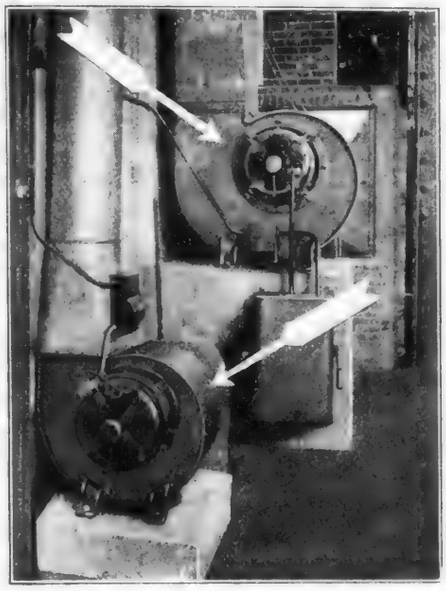
Central Supply Association, held its ninety-second regular meeting in Chicago, February 20. Among the new members elected were Johns-Manville, Inc.; H. Mueller Mfrg. Co., Decatur, Ill.; and W. A. Russell Co., New York. **Franklin D. Jones,** of Washington, addressed the meeting on "Trade Associations and the Law." **E. L. Brown,** apprenticeship director of the National Trade Extension Bureau, spoke impressively of the imperative need for every possible aid and encouragement of apprenticeship work. "Unnecessary Fluctuations" were discussed by E. I. Leighton, general manager of the Leighton Supply Company. Other speakers were John D. Tschopik, C. V. Kellogg, Martin J. Beirn, M. M. Mangasarian, who delivered a notable address on "the Mission of the Modern Business Man;" and Isidor Weil, president of the Weil-McLain Co., who spoke on boilers and radiators. The annual meeting of the association will be held in Chicago, October 22-23, 1924, at the Drake Hotel.

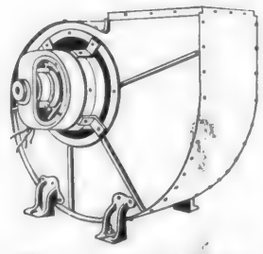
ILG

Universal Blowers are compact and interchangeable. They require no special pedestal for motor. There are no bearings in the suction inlet. All oiling is done on the motor or pulley side. These and other exclusive features are shown in a complete catalog. Send for it.



Belt Driven Type. Note Absence of Pedestal for Pulley.





Direct Connected Blower. Note Compactness!

There are a surprising number of ILG Universal Blowers in use in every part of the country. They are being specified by leading Architects and Engineers.

HIGH EFFICIENCY ILG VENTILATING MACHINERY

Ventilation

FOR OFFICES · STORES · FACTORIES · PUBLIC BUILDINGS · RESTAURANTS · THEATRES · HOUSES · ETC ·

ILG ELECTRIC VENTILATING CO. 2858 NORTH CRAWFORD AVE. CHICAGO

BRANCHES IN ALL PRINCIPAL CITIES

The Right Way to Insulate Underground Pipes

The fundamental design of the Johns-Manville Underground System of Insulation is based on the experience of a company that has been highly successful in insulation work for over fifty years.

The planning of the details of each specific underground installation is in the hands of men who have planned many of the largest steam and hot water installations in the country.

In addition the actual construction of every job is always supervised by an experienced Johns-Manville engineer, and we prefer to have the work done by our own trained workmen.

In this way, careful design, planning and construction are combined to give you completely satisfactory underground insulation lines.

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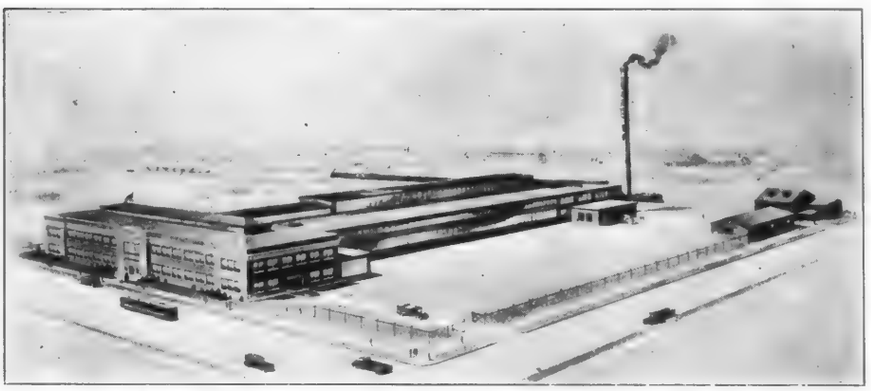
294 Madison Ave., at 41st St., New York City
Branches in 61 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

Through Asbestos and its allied products
INSULATION
BRAKE LININGS
ROOFINGS
PACKINGS
CEMENTS
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Underground System of Insulation

Warren Webster & Co., Camden, N. J. manufacturers of steam heating systems, feed-water heaters and steam specialties, has moved into its new plant at Federal and Seventeenth Streets, Camden. A feature of the new home of the company is an arrangement whereby its heating system may be used in connection with experimental tests. The new plant consists of a two-story building, with stock and shipping rooms on the first floor and offices on the second floor. The manufacturing plant adjoins in the rear and extensive laboratories are included.



Warren Webster & Co.'s New Plant in Camden, N. J.

Gasteam Radiator Co., St. Louis, Mo., is the new name of the former Williams Radiator Co., St. Louis. William L. Schmoll of J. B. Clow & Co., Chicago, is at the head of the business.

American Schaeffer & Budenberg Corporation, Brooklyn, N. Y., has acquired the important assets, including the well-known line of Honeco thermometers and temperature controllers of the firm of Hohmann-Nelson Co., Eau Claire, Wis. In connection with the consolidation, announcement is made that the personnel of the Honeco organization, including President A. J. Nelson and department heads have been retained by the new owners. The combination, it is pointed out, greatly strengthens the facilities of the company and assures Honeco users of adequate service.

Hoffman Specialty Co., Waterbury, Conn., has opened a new warehouse at 747 Warehouse St., Los Angeles, Calif., where a complete line of the company's products will be carried for the benefit of Pacific coast trade.

Ohio Brass Co., Mansfield, O., has purchased a tract of approximately five acres with improvements from the Aultman-Taylor Machinery Co. The new property is located directly across the Pennsylvania Railroad tracks from the company's present headquarters, and is bounded, triangular fashion, by three trunk line roads.

W. A. Russell & Co., Grand Central Terminal, New York, announces that it has increased its capital stock to $250,000,

Kewanee Boiler Co., Kewanee, Ill., directors were re-elected at a recent meeting of stockholders and subsequently the directors re-elected all officers, including President E. E. Baker.

Yeomans Brothers Co., Chicago, Ill., manufacturers of sewage ejectors and pumping machinery, has opened two new district sales offices as follows: Toledo, O., 752 Euclid Ave., covering northwestern Ohio in charge of A. Carle Rogers, and Seattle, Wash., 2021 L. C. Smith Bldg., central and northwestern Washington, in charge of the Godfrey Jones Company.

Abram Cox Stove Co., Philadelphia, Pa., celebrated the completion of the largest sales volume in its 77 years' history recently at a conference of salesmen in Philadelphia. Among the speakers at the banquet held in the Sylvania Hotel were President A. C. Mott, Vice-President A. C. Mott, Jr., E. F. Glore, general sales manager; John W. Jones,

PUBLIC SCHOOL No. 62, BRONX, New York City, N. Y.
Over one Hundred Lehigh Fans are installed in New York City Schools
Engineers—New York Board of Education.
Contractors—Federal Heating Co., New York City

LEHIGH MULTIBLADE FANS

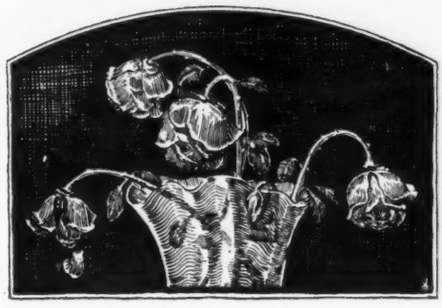
FOR HEATING AND VENTILATING

WHERE large volumes of air are to be handled at comparatively low pressures such as in heating and ventilating systems LEHIGH Multiblade Fans are guaranteed to be equal to, if not superior to, any other fans on the market.

HERSH BROTHERS CO.

654 Mill Street **ALLENTOWN, PA.**

The Flowers that Drooped and the Tale they Told!



That morning one her pupils had brought her roses as a valentine. Now, at the close of school, she found them wilted and lifeless.

It was a small disappointment but it gave her the clue to the reason for a bigger one. Suddenly she realized why her class had been falling behind, why the pupils she had found so quick and bright early in the Fall seemed duller, less interesed in their work.

They lacked fresh air! Judging by her own convenience, engrossed in her work, she had not realized the particular need of fresh air, of the right temperature and of the right volume in the schoolroom.

Without proper ventilation it is impossible to realize fully on the expensive machinery of education. The best of teachers and equipment will not overcome the handicap of poor heating and ventilating. Leading architects and engineers are finding it more satisfactory to care for the individual needs of individual school rooms by the Unit System of heating and ventilating.

The Buckeye Heatovent heats and ventilates each room separately according to requirements worked out in advance by engineers trained to look upon individual rooms as individual problems. Each room has its own unit controlled by the touch of a button. The economy of heating and ventilating rooms only when actually in use effects remarkable fuel savings.

Write any of our offices for full information.

BUCKEYE BLOWER COMPANY

COLUMBUS, OHIO

324 Monadnock Block, Chicago, Ill.
372 Whitehall St., Atlanta, Ga.
Case & Morse
1018 4th Ave., Seattle, Wash.
1400 Broadway, New York, N. Y.
15 East Fayette St., Baltimore, Md.
708-10 Columbia Bank Bldg., Pittsburgh, Pa.
333 Jackson Building, Buffalo, N. Y.

assistant general salesmanager; and Edward Nigg, general superintendent.

Honeywell Heating Specialties Co., Wabash, Ind., has started negotiations for the leasing of 25,000 sq. ft. of additional floor space because of the continued growth of its business.

Monarch Metal Products Co., St. Louis, Mo., announces that A. F. Nagle Co., Inc., 10 East 43rd Street, New York, has been appointed district representatives for the New York district to render personal service to the building profession in the use of Monarch adjustable metal weather strips.

National Regulator Co., Chicago, Ill., manufacturer of the National system of temperature regulation, and other heating specialties, announces the removal of its

New Plant of National Regulator Company.

general offices and manufacturing plant to the company's new building, 2301-2311 Knox Avenue, Chicago.

Abram Cox Stove Co., Philadelphia Pa., at the annual meeting of its directors, held in the company's Philadelphia offices, February 15, elected the following officers: Chairman of the board, Abram C. Mott, Sr.; president, Abram C. Mott, Jr.; treasurer, E. F. Glore; secretary, Merle E. Mott.

Gorton & Lidgerwood, New York, has has appointed Charles A. Mann as sales representative for the Chicago territory, with headquarters at 155 North Clark Street. George D. Chadeayne, heating engineer, formerly of New Haven, Conn., is now representing the company in the New York City and Westchester Territory.

American Radiator Co., New York, announces the retirement from active service in an executive capacity of A. A. Landon, vice-president of the company. Mr. Landon will become counsellor to the executive committee and to the advisory board in Paris. Mr. Landon has been in the employ of the company since 1895 when he was appointed superintendent of the company's Kalamazoo plant. At the time of his retirement he was vice-president and assistant to the president, with supervision over manufacturing. The announcement of the company concludes with the statement that "the severance of a lifelong affiliation of a man of Mr. Landon's rightful claims for personal and business admiration, is most regrettable and it is a matter of great satisfaction to the company that he has consented to serve as counsellor to the executive committee, in the States, as well as in Europe."

Gurney Heater Mfg. Co., Boston, Mass., announces the appointment of George W. Kenney as manager of its New York branch, succeeding R. B. Hunt, whose ill health was long a source of concern to his many friends. After a short rest, Mr. Hunt intends to continue in the heating trade. Mr. Kenney has been connected with the company's home office in Boston and was a former representative of the company in the Hudson Valley and metropolitan districts.

Richmond Radiator Co., New York, announces the opening of a Boston branch office under the management of J. J. Bennett, who, for the past six years has been manager of the heating department of the Washburn-Garfield Co., Worcester, Mass. He was New England manager of the Richmond Radiator when the company was first organized.

Vulcan Sheet Metal & Mfg. Co., Inc., 45 Fulton St., New York, announces that George B. Svenson, formerly connected with the General Electric Company for fifteen years as engineeer, is now associated with the Vulcan Company. In order to take care of increased business, the Vulcan Sheet Metal & Mfg. Company was recently reincorporated with a capital stock of $25,000, and Mr. Svenson made vice-president, in charge of the company's sales engineering department. Clinton H. Quirk is president and manager of the company.

Merkel Bros. Co., Cincinnati, O., manufacturer and distributor of heating and plumbing supplies, has awarded a contract to The Austin Company, general contractors, Cleveland, for a complete new plant, consisting of a mill building, three stories high, 100 ft. x 220 ft.; pipe building two stories high, 100 ft. x 320 ft.; garage, boiler room, coal storage, and all mechanical equipment, including railroad track construction. The

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is one that every Heating Engineer will agree is of vital importance

Burt Metal Top Sliding Sleeve Damper Ventilator

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All buildings where a large number of people are employed, should be given the best possible equipment for ventilation and for lighting by daylight.

An opportunity for increased business and a lucrative line of work for sheet metal workers presents itself in every type of building, new or old. Burt Ventilators and Burt Service will help you get this business.

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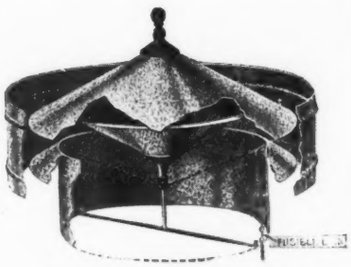
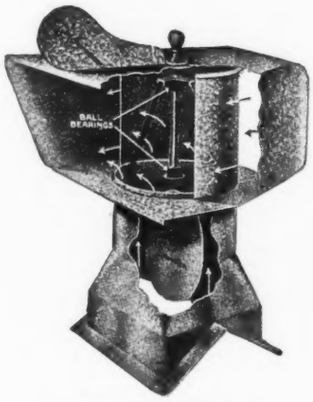
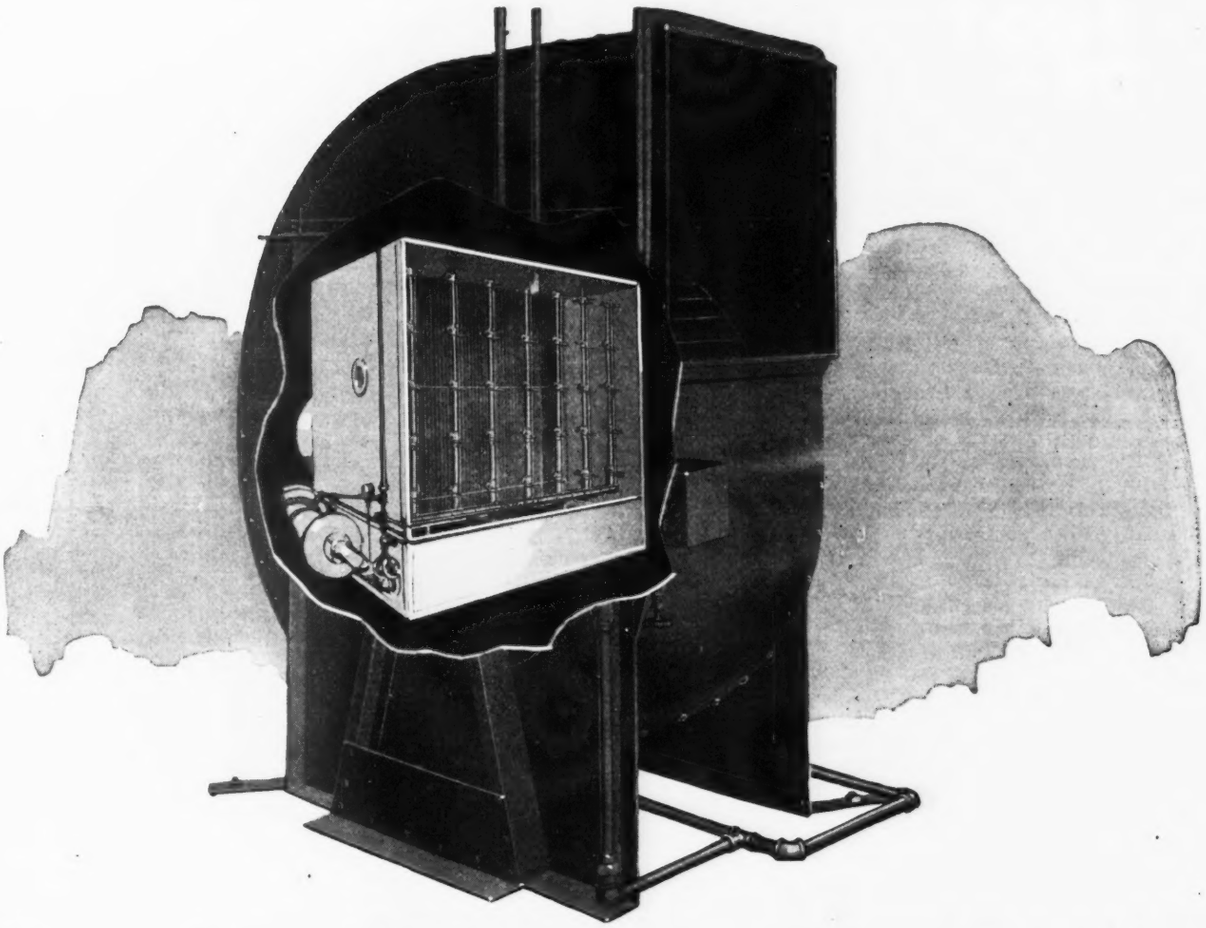


Burt Fire Retarding Cone Damper Ventilator



Burt Ball Bearing Revolving Ventilator



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All the air that goes through any air washing system must go through the fan. Ordinarily it is washed by a purifier that is separate and distinct from the fan.

Here is a complete air washing system where the washing is done ***inside the fan.*** The big purifier is done away with—the floor space it occupied and a large part of the cost are saved. With the Air Washing Fan humidity is under more perfect control and there is a decided economy of power and water.

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project will cost $500,000. This contract is one of the largest of its kind awarded in the Ohio district since the first of the year.

Business Changes

Harry M. Nobis, Cleveland, O., formerly with the Weiss Heating & Plumbing Co., Cleveland, O., has opened an office as heating and ventilating engineer at 2036 East 105th Street, Cleveland. Mr. Nobis will specialize in the design of Atmospheric systems of heating and in the design of oil-burning and smoke-consuming apparatus.

American Association of Oil Burner Manufacturers announces that its next annual meeting will be held in St. Louis, Mo., April 1-3, at the Hotel Chase. Exhibits will be shown of oil burners and oil-burning equipment. The meeting is expected to attract industrial burner manufacturers, domestic burner manufacturers and distributors of both industrial and domestic burners and of oil-burning equipment.

Ed. E. Sendelbach, Bloomington, Ill., installing steam heating and power plant for the $400,000, Horatio G. Bent School, Bloomington, Ill.

University City, Mo.—A new grade school to cost $100,000, will be built in the Graveling tract in University City by the school board of that city. The architects are Ferrand and Fitch, Washington University, St. Louis, Mo., who have retained the Terrell Croft Engineering Co., St. Louis, to engineer the electric, heating and ventilating installations for the project.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

ENGINEER WANTED—One of the largest heating and ventilating companies has an opening for an experienced engineer-designer who is capable of taking charge of contracts running from $25,000 upwards, preparing and supervising the preparation of detailed working plans and effecting economies without sacrificing quality. There is an unusual opportunity for one who possesses the ability, knowledge and initiative to satisfactorily fill this position. Give full details and salary expected. Address Box 34, care of Heating and Ventilating Magazine.

ENGINEER WANTED—Young man thoroughly familiar with designing and detailing of heating and ventilating apparatus, in organization handling high-class installations. State fully qualifications and experience. Address Box 35, care of Heating and Ventilating.

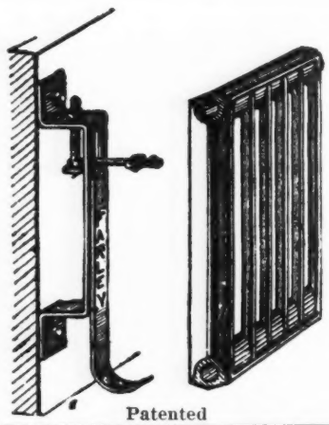
POSITION WANTED—Available at once, capable heating engineer for position of heating estimator, sales engineer or assistant sales manager. Graduate engineer, 28 years old, with excellent experience. Can furnish A-1 references. Willing to locate anywhere. Open for immediate acceptance. Address Box 36, care of Heating and Ventilating Magazine.

FOR SALE—Plumbing, heating and sheet-metal business. A first-class shop, established 1886, in a city of 100,000 population, centrally located and equipped with material, tools and 1¼-ton Reo truck for complete and efficient operation of all three crafts. The cause for disposal of this excellent business is the death of one of the members of the firm who had charge of this department. Sale price right for quick disposal. Address Box 21, care of Heating and Ventilating Magazine.

WANTED—By a live sheet-metal contractor, an engineer (with salesmanship organization ability) to design and lay out drying, heating, ventilating, exhaust and conveying systems in textile, paper, planing and wood-working mills. Address Box 31, care of Heating and Ventilating Magazine.

QUOTATION WANTED—Quote your lowest price C. O. D., subject to inspection, on the following used tools, which must be in first-class condition: One No. 2 and one No. 3 Toledo adjustable pipe threading device, one No. 250 and one No. 350 Toledo pipe cutter, two Toledo ratchet boring tools, with 1½-in., 2-in and 2½-in. bits, one Toledo power drive, with 110-220-volt, 60-cycle, 3-phase motor, one No. 66 Reed or other make pipe vise, with a capacity of 1½-in. to 12-in. pipe, one No. 100 Toledo P-D threading device, one Vosper pipe cutter. Address Box 32, care of Heating and Ventilating Magazine.

POSITION WANTED—By young man of 30. Ten year's experience as superintendent of central station heating company. What have you to offer? Address Box 33, care of Heating and Ventilating Magazine.



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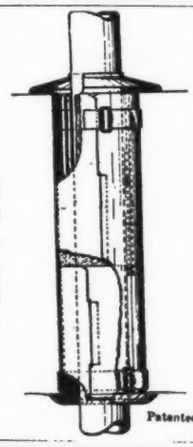
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